

# TECH VIBE

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**INVENTE 5.0**  
22nd, 23rd January 2021



# Contents

- Editorial
- Meet the Team
- President's Desk
- Principal's Desk
- Department Bulletin board
- Current Trends
- Projects
- Research

# Editorial

If the year 2020 has taught us anything, it is that life is unpredictable. Except it isn't.

As the popular author Mark Twain once said, "History may not repeat itself, but it often rhymes." Pandemics as such, are not an uncommon occurrence in the annals of world history and have been consistently devastating for human livelihood, but what is unnatural is our refusal to learn from them.

In the year of 1918, the influenza pandemic broke out in the city of Bombay, in the middle of a failed monsoon and an ongoing famine, exacerbating what was already a terrible disease. One which resulted in the death of over 12 million Indians and the worst economic crisis the country had ever faced.

Now, almost a century later, the effects of covid-19 are not as calamitous to human life, particularly due to prompt government response and the development of new technological countermeasures but the similarities remain. Especially the breakdown of supply chain systems, unavailability of life saving masks and sanitizers, and sellers hoarding and scalping existing supplies during the initial few months of the pandemic. Additionally, the economic effects remain the same, if not worse, with rising job losses and severe growth stagnation.

It would not be an exaggeration to say that India was not prepared to deal with a nationwide shutdown and prolonged social distancing. Bill Gates forewarned the world in 2015 that many countries had not invested in a dedicated system designed to combat future pandemics and he was right, and that complacency has proven costly.

It would be optimistic to hope that this will be the last time we will ever face such a situation but as engineers, it is prudent to recognize that while we may not be able to predict when the next pandemic will hit, it is well within our control to decide how we respond to them, and considering all of our best interests, it is important we respond well.

*Raghav Sudhan K  
Editor, Tech Vibe 2020*

# Meet the Team

## Editor

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## From the President's Desk

Dr. Kala Vijayakumar  
President  
[kala@ssn.edu.in](mailto:kala@ssn.edu.in)

One of the primary objectives of SSN is to create well rounded graduates who are able to give back to society. SSN is stepping into its 25th year. When we look back we realise that we have remained focused on the holistic development of our students all through since inception. Our students are encouraged to excel in multiple facets such as academics, research, co-curricular activities, extra-curricular activities, sports, entrepreneurship and social service among other areas.

Invente, the annual symposium, is an event organized completely by students to showcase exemplary co-curricular achievements and encourage knowledge transfer amongst the student community throughout India. Invente has established itself as one of the premier tech fests in the country with students from all over the nation looking forward to it every year. This year, the event is going virtual and promises to offer a unique platform for young minds to connect with each other over co-curricular events. The symposium displays the combined efforts put forth by all engineering departments of SSN. It further helps in the development of organizational skills and imbibes collective social consciousness amidst students.

I believe that this symposium would be an ideal opportunity to foster innovative skills in addition to technical competence, making it a fine learning experience for the students.

I wish the students, participants, organisers and others involved with Invente 2021, all the very best for successful conduct of the symposium.

**Dr. Kala Vijayakumar**



# From the Principal's Desk

Dr. V.E. Annamalai  
Principal  
[annamalaive@ssn.edu.in](mailto:annamalaive@ssn.edu.in)

Sri Sivasubramaniya Nadar College of Engineering has a vision of transforming people's lives through Education. The Mission is to provide all round growth. Growth in a student is not only the academic growth but also the growth in societal skills. The four years in this campus is knitted with several activities that provide an immersive experience in Academics, Sports, Research and Extracurricular activities. This is a Second Home that provides youngsters an opportunity to explore their inherent skills to fly high, with the confidence that they can always land in safe grounds.

One such experience building exercise is the opportunity to conduct a massive 'Skill showcasing event' called Invente. True to its name, it is an Inventive step that brings about the Innovative innate skills of students. When so many events are showcased, just like a tuning fork syncing at the right frequency, the heart aligns with what it likes. It is a rare event where every student discovers his/her skill and identifies what is their passion in life.

While externally it appears like an event, internally, in the heart of hearts, it is a disciplined festival that sets many a soul in its life's trajectory. Those who conduct, learn enormous skills in Management. Those who participate learn a lot on how far they have to go to become a professional in their field of passion. People like us who simply sit and watch, enjoy the level of maturity, our children have achieved in organizing an event of such a scale. In all aspects, Invente is an unmatchable learning process. This year, it is an additional learning to learn to do all this online.

I welcome you all to the next phase of learning.

Dr. V.E. Annamalai

# **FROM THE DEPARTMENT BULLETIN BOARD**

## **Department of Computer Science and Engineering**

I am extremely happy to see that the enthusiasm of our students is not dampened by the prevailing Covid-19 pandemic scenario. It is heartwarming that notwithstanding the pandemic, the students are rolling out yet another edition of the joint national level technical symposium, INVENTE. Acquiring inter-disciplinary skills seems to be the most crucial requirement in today's changing technological landscape. INVENTE serves as a forum for students to look beyond their respective disciplines and think about creative and innovative ways of combining the knowledge from multiple disciplines to solve scientific/societal problems of significance. In addition, the symposium nurtures leadership abilities and team playing skills too. I appreciate the technical team for introducing new events such as Web-it-out (a web design competition), App-off (Mobile app development competition) and Mock job drive this year in addition to the all-time favorite events such as CodOlympics, Paper Presentation and UXI contest. Fun-oasis is a new non-technical event that has been introduced. I congratulate the whole team for their efforts and wish the event every success.

**Dr. Chitra Babu**  
**Head of Department**  
**Computer Science and Engineering**

## **Department of Electrical and Electronic Engineering**

The Association of Electrical and Electronics Engineers of the Department of EEE is proud to be part of SSN InvenTE 5.0, an intercollegiate technical symposium. On this occasion, it gives me immense pleasure to pen a few words about this event. Symposia serve as a diverse platform for exchange of technical ideas and open the doors for learning and interaction. InvenTE is conducted keeping in mind of the above viewpoint and provides a great opportunity for students to exhibit their prowess and talent as participants and organizers. I appreciate the faculty and students for their contribution to InvenTE 5.0 and in coordinating the events of this symposium. As the saying goes “Coming together is a beginning; keeping together is progress; working together is success”. Hope that we score higher and better in all the endeavours. At this juncture, I would like to extend my heartfelt wishes for the success of this event.

**Dr. V. Kamaraj**  
**Head of Department**  
**Electrical and Electronic Engineering**

## **Department of Mechanical Engineering**

INVENTE has always been a festival celebrating student innovation. A grand stage designed to showcase the capabilities of the next generation of engineers, with a variety of events designed to highlight their novel ways of overcoming challenging problems. Organizing the fifth iteration of this technical symposium, especially in the middle of this pandemic, was not without its difficulties but I’m proud to say, through the concerted efforts of all eight departments, INVENTE 5.0 hopes to be just as ambitious as all previous years.

I wish all participating students the very best, and do hope they make use of this opportunity to further their knowledge and form connections that will aid them in their professional journey.

**Dr. N. Nallusamy**  
**Head of department**  
**Mechanical Engineering**

## **Department of Electronics and Communication Engineering**

It is a moment of great honour and privilege for me to greet you as the HoD of ECE. InvenTE 5.0 is a national level online technical symposium organized by Association of Engineers, SSNCE, Chennai. The tech extravaganza has steadily grown in popularity over the years and has stood out as one of the finest symposiums in the country. The fest has been host to a mosaic of student-organized events which will help the participants explore the intricate fabrics of technology/engineering and this edition will continue the same. The success of InvenTE 5.0 is entirely reliant on the magnanimous efforts of the students and the enthusiastic motivation from the faculty. I acknowledge my heartly appreciation for all those who have worked tirelessly for the success of this fest. I sincerely wish that this regimen would continue to be instilled in the upcoming editions of this phenomenal event.

**Dr. Radha S**  
**Head of Department**  
**Electronics and Communication Engineering**

## **Department of Civil Engineering**

I am extremely delighted to welcome you all for the annual Technical Symposium INVENTE 5.0. This event plays a major role in shaping the students as a well-rounded individual who is fit and confident to face the world after graduation. It allows interdepartmental and inter collegiate networking across the country. The pandemic has had an impact in the students' life, but that has never stopped us from organizing this edition of INVENTE 5.0 online. We have many exciting events in INVENTE 5.0 such as Build-a-thon, CAD-a-thon, Paper Presentation, Just add KLVs etc. These will surely make you excited and will be a wonderful event to remember. I appreciate our Association of Civil Engineers team for bringing out this version of INVENTE 5.0 and wish the event a grand success.

**Dr. N. Sivakumar**  
**Head of Department**  
**Civil Engineering**

## **Department of Biomedical Engineering**

Biomedical engineers have always been a bridge connecting technology and healthcare. And this year, with the pandemic paralyzing the entire world, we all have witnessed the extraordinary roles played by Biomedical Engineers in saving and supporting humankind. And we, the Department of Biomedical Engineering take this opportunity to add the flavor of healthcare to the National Level Technical Symposium INVENTE. InvenTE has been and will always be the pride of SSN, bringing together the faculty and student communities to work in harmony to give the best platform to explore and get exposed to different domains. It will give you a taste of the biomedical engineer's role along with a lot of fun elements. You don't just test your technical skills but get a chance to portray your passion, teamwork, communication, and a lot more. Dive into the big ocean called InvenTE and start your journey to discover your true interests. Let INVENTE 5.0 bring out all the talent and be a forum for interaction and inspiration. My best wishes to all the organizers and participants.

**Dr. A. Kavitha**  
**Head of Department**  
**Biomedical Engineering**

## **Department of Information Technology**

INVENTE, has been and will always be the pride of SSN, bringing together the rich faculty and student communities to work in harmony. Aside from the previous years, this year, the fifth edition of the tech fest, INVENTE 5.0, is organized virtually by virtue of the pandemic in a newer and voguish way, which is not a smaller task with innovative ideas behind each event providing a whole new world of fresh perspective and dimension to students. With best wishes to the team and its participants, I hope this INVENTE culminates in a grand display of technical prowess, sending home students with proactive ideas to reflect upon!

**Dr. T. Nagarajan**  
**Head of Department**  
**Information Technology**

# **Department of Chemical Engineering**

It gives me immense pleasure that my students of Chemical Engineering are organizing the National Level Technical Symposium INVENTE on the 22nd and 23rd of January 2021 with great enthusiasm. The event is an excellent platform for participating in various technical events, non-technical events and gaining knowledge of recent techniques and approaches through multidisciplinary workshops and technical sessions.

I encourage the students to take advantage and utilize the diverse events that have been planned to foster your personal growth and career exploration.

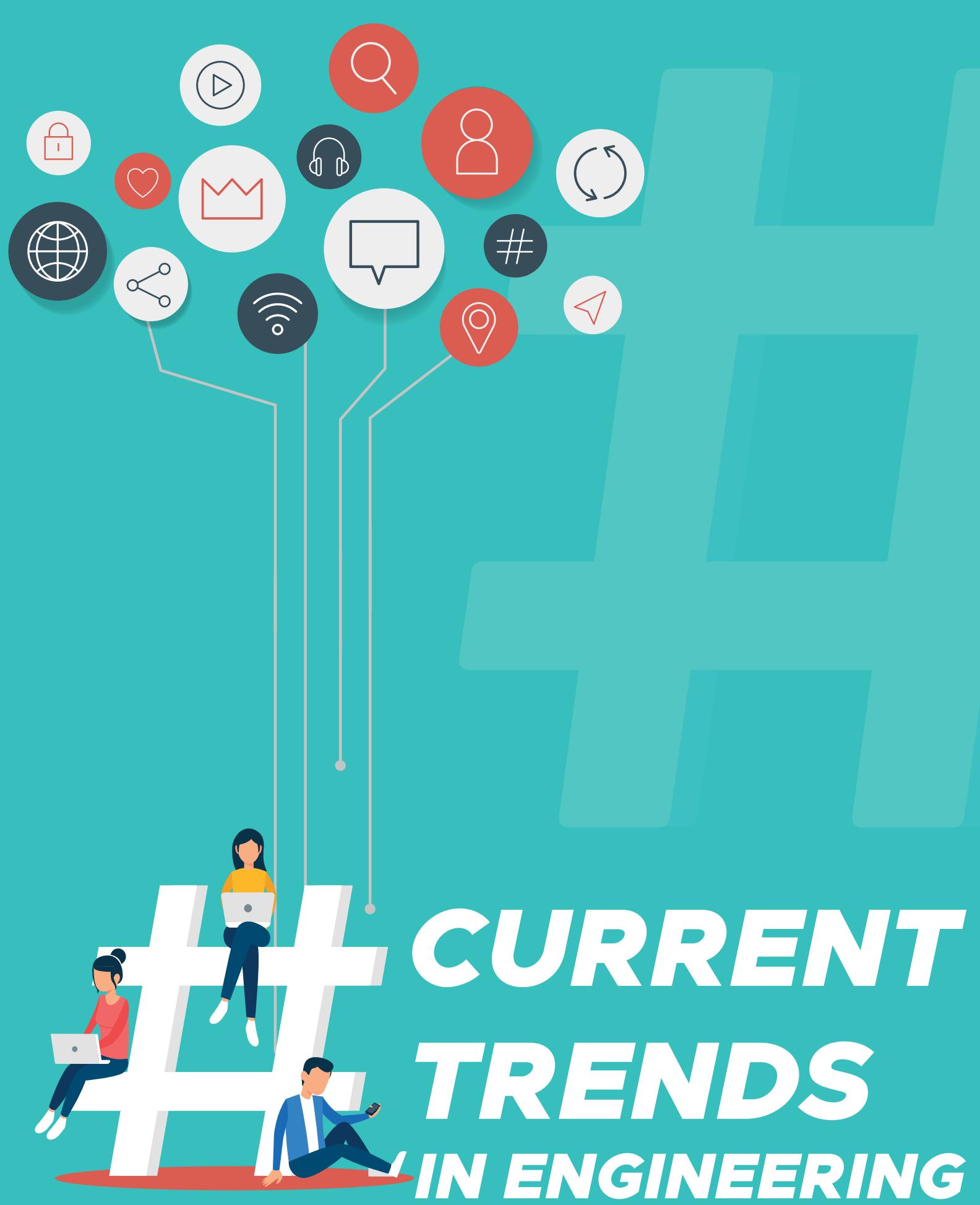
I wholeheartedly wish and hope that INVENTE 5.0 will pave the way for an excellent opportunity for the student community to interact with the fellow students and enhance the presentation and skills of teamwork.

**Dr. R. Parthiban**  
**Head of Department**  
**Chemical Engineering**

## **Advisor of Student Affairs**

INVENTE's unique landscape of blending challenging problems with fun filled entertainment has always been possible due to the hard work and combined efforts of SSN students. This has become even more apparent during this pandemic, with students of all departments making concerted efforts to bring this technical symposium to life virtually. It brings me great pleasure to invite all participants to take part in INVENTE 5.0, and believe that the upcoming two days of workshops and events will be a fruitful and intellectually stimulating time for them.

**Dr. Sunita Nair**  
**Professor, Department of Chemistry**  
**Advisor of Student Affairs**



# CURRENT TRENDS IN ENGINEERING



# DEPARTMENT OF BIOMEDICAL ENGINEERING

## 3D PRINTING

3D printing is a rapidly growing research area, which significantly contributes to major innovations in various fields of engineering, science, and medicine. 3D printing is an additive manufacturing technique that creates three-dimensional objects by building successive layers of raw material such as metals, plastics, and ceramics. The objects are produced from a digital file, rendered from a magnetic resonance image (MRI) or a computer-aided design (CAD) drawing, which allows the manufacturer to easily make changes or adapt the product as desired. 3D printing approaches can differ in terms of how the layers are deposited and in the type of materials used. A variety of 3D printers are available on the market, ranging from inexpensive models aimed at consumers and capable of printing small, simple parts, to commercial grade printers that produce significantly larger and more complex products.

One of the highlights of the 3DHEALS 2020 virtual conference on June 6 and 7, 2020 was a keynote from Sam Onukuri, senior fellow at Johnson & Johnson 3D Printing. He explained how Johnson & Johnson is leveraging 3D printing technology to transform design, manufacturing and delivery across its medical device, consumer and pharmaceutical businesses.

From Covid-19 test kit swabs to more affordable, accessible prosthetic limbs, several key 3D printing innovations have hit the medical industry this year.

From Covid-19 test kit swabs to more affordable, accessible prosthetic limbs, several key 3D printing innovations have hit the medical industry this year.

### ***"3D printing supporting the fight against Covid-19 pandemic"***



One of the biggest problems with the coronavirus is the number of patients that require intensive care and oxygenation to be able to survive and attempt to fight it off. This means that reanimation machines are working overtime and when/if they break down, it's a serious issue. A Northern Italian hospital had lost the supplies of valves for reanimation devices, and the supplier could not get any more of them in a short time. Lonati workers, Michele Faini and Marco Gavazzi, together with ISINNOVA AD Cristian Fracassi's design, were able to produce valves for intensive care devices using Lonati's new 3D printer in a very short time. The 3D printer was brought straight to the hospital and was

producing the new valves in just a few hours. According to Interesting Engineering, patients at the hospital with COVID-19 were benefitted from 3D-printed valves.

## ***"Bioprinted Section of the Spinal Cord"***



The scientists first printed out small implants made of soft gel, then filled them with neural stem cells, again using a printer. The implants were then surgically placed inside a tiny gap in a rat's spinal cord. The precision 3D printing allowed the soft gel and cellular matrix to fit accurately into the gap, or wound, said Shaochen Chen, a professor of nanoengineering at the university and a team leader. The scientists at USCD printed out small implants made of softgel and filled them with neural stem cells. Image: University of California, San Deigo.

Over time the new nerve cells and axons grew and formed new connections across the cut spinal cord of the animal. These nerve cells connected not only with one another but with the host spinal cord tissue and the circulatory systems of the rat. The lab-grown cells then successfully bridged the gap in the spinal cord and partially restored movement to the animal's hind quarters, said Mark Tuszinski, a professor of neuroscience at the university.

The researchers said that bio printed tissue can be used to test the effects of drug treatments and, eventually achieve the 3D bioprinting goal: printing entire organs that can be grown and then transplanted into a patient.

**- Sharmilee S,  
Department of BME,  
IV Year**

# RECENT ADVANCEMENTS IN BIOMEDICAL ENGINEERING

## ***LG Air Purifier Mask Makes Breathing Easy:***

Many innovative solutions have mushroomed during the pandemic time and various companies and laboratories have made significant contributions to battle the virus. One of the notable inventions, made by the giant South Korean electronics manufacturer LG, is the launch of a face mask that can purify air and make breathing easier.



The LG PuriCare Wearable Air Purifier features two replaceable H13 HEPA filters that the firm already employs in its house air purifiers. Two built-in fans push air through, coordinated with the wearer's breathing thanks to a sensor that detects respiratory activity in real time. Both the rhythm and air volume are measured, similar to those in positive air pressure devices that are used to help with sleep apnea. The air moved by the fans is continuously adjusted to compensate and make it feel more like you're not wearing a mask.

The fans, sensors, and electronics are powered by a 820 mAh battery that can keep the mask going for eight hours in low mode and two hours on max.

The device comes with a charging case that has UV-C LEDs inside to kill any germs that land on the mask's exterior while it was in use.

## ***Wireless Brain Implant to Give Sight to Blind:***

Scientists in Australia are gearing up for clinical trials of a brain implant that may restore limited sight in blind people. Developed at Monash University in Melbourne, the Gennaris system involves bypassing the eye completely and targeting the vision center of the brain.



A person would wear a pair of glasses outfitted with a camera that, via a computer, feeds what it is seeing to the brain implant. The wireless implant is positioned on the surface of the brain and it can generate 172 different bright spots that the person can see. By properly producing these so-called phosphenes, it should be possible to provide rudimentary visual information about what's in front of the user. This has implications for a host of conditions that render the eye, as well as the optic nerve, dysfunctional and so gives hope to those that were once thought to not have a chance to ever see again.

The new implants are quite small and, because they don't require wires to protrude through the scalp, they can stay implanted for a long time without the worry of infection. While the system is being designed specifically to restore vision, the same technology has the potential to help overcome paralysis in many patients by bypassing injured nerves and linking stricken limbs directly to the brain. The existing prototype includes a head worn device that has a camera, vision processing hardware and software, a wireless transmitter, and the implant that consists of 9×9 millimetre tiles.

**- Sivagami Vishnu Kuma,  
Department of BME,  
III Year**



# DEPARTMENT OF CHEMICAL ENGINEERING

## ELECTROCHEMICAL SENSORS: A Solution to Pollution Detection

### **WHAT IS ELECTROCHEMICAL SENSOR ?**

Electrochemical sensors are devices that give information about the composition of a system in real-time by coupling a chemically selective layer (the recognition element) to an electrochemical transducer.

A device that transforms chemical information ranging from the concentration of a specific sample component to an analytically useful signal. Electrochemical sensors work based on the changes in electrical potentials due to chemical reactions.

Electrochemical detection is a powerful analytical method that can detect electric currents generated from oxidative or reductive reactions in test compounds.

### **WORKING PRINCIPLE OF ELECTROCHEMICAL SENSOR**

This electrochemical sensor consists of a sensing element which are made of predominantly noble metals, metal oxide, and carbon nanotubes which targets the specific analyte as per the requirement. Based on the changes in the concentration or potential of the analyte when it comes in contact with the sensing element a chemical signal is sensed this chemical signal is converted to an electrical signal by a transducer element. Based on the magnitude of the electrical signal the chemical signal results of the analyte are interpreted.

### **OKAY, WHAT'S THE NEED FOR ME TO WRITE ABOUT ELECTROCHEMICAL SENSORS HERE!!!!**

Water is essential for every life living on the planet. However, we are facing a more serious situation such as water pollution since the industrial revolution. Fortunately, many efforts have been done to alleviate/restore water quality in freshwaters. Across the globe, the controlled or uncontrolled release of environmental contaminants, e.g., toxic heavy elements, antibiotics, and pesticides to the environment is a serious concern. Considering this global issue, there is an urgent need to design and develop strategic measuring techniques with higher efficacy and precision to detect a broader spectrum of numerous contaminants. The development of precise instruments can further help in real-time and in-process monitoring of the generation and release of environmental pollutants from different industrial sectors. Moreover, real-time monitoring can also reduce the excessive consumption of several harsh chemicals and reagents with an added advantage of on-site determination of contaminant composition prior to discharge into the environment. In this context, electrochemical biosensors have proven to be useful tools to detect small sample volumes, low concentrations of biological and chemical components, and sometimes miniaturized analytical devices. Low sample concentration and the lack of selectivity and sensitivity of traditional methods are among the significant bottlenecks of conventional methods. Moreover, conventional methods (e.g., chromatography) require long and specialized sample pre-treatment, which may potentially translate to time-consuming processes. With key scientific advances, electrochemical biosensors have gained considerable attention to solve this problem. Electrochemical biosensors can be an excellent fit

as an analytical tool for monitoring programs to implement legislation. The ability to design highly specific recognition sites makes biosensors a suitable alternative to traditional chromatography-based methods. Electrochemical-based techniques for sensing pollutants can be categorized as potentiometric, amperometric or coulometric, voltammetric (incorporating preconcentration and stripping steps), and conductometric.

## **ADVANTAGES OF ELECTROCHEMICAL SENSOR OVER CONVENTIONAL DETECTION TECHNIQUES**

- Can be specific to a particular gas or vapor in the parts-per-million range. The degree of selectivity depends on the type of sensor, the target gas, and the concentration of gas the sensor is designed to detect.
- Linear output, low power requirements, and good resolution.
- Excellent repeatability and accuracy. Once calibrated to a known concentration, the sensor will provide an accurate reading to a target gas that is repeatable.
- Does not get poisoned by other gases. The presence of other ambient vapors will not shorten or curtail the life of the sensor.
- Less expensive than most other gas detection technologies. Unlike infrared and PID technologies, electrochemical sensors are economical.

**- PRASANTH S.M,  
Department of Chemical Engineering,  
IV Year**

# MEMBRANE BIOREACTORS IN WASTEWATER TREATMENT

## INTRODUCTION

Anaerobic membrane bioreactor (AnMBR) technology is one of the emerging mainstream technologies used for municipal wastewater treatment, which allows the production of renewable energy in the form of methane, and high-quality effluents are obtained which are free of suspended solids. It is a combination of a conventional biological treatment system and physical liquid-solid separation which employs membrane filtration in a single system. The anaerobic membrane bioreactor (AnMBR) has been considered as an alternative to the conventional activated sludge (CAS) process for wastewater treatment as the bio-energy recovered from wastewater lowers the capital spent on fuel and the expenditure of constructing precipitation tank and land occupation can be completely saved.

## SETUP & WORKING OF MBR

Membrane separation is administered either by pressure-driven filtration in side-stream MBRs or with vacuum-driven membranes immersed directly into the bioreactor in submerged MBRs. The AnMBR set-up mainly consists of a jacketed CSTR connected to an external membrane module. The membrane system was maintained at a constant transmembrane pressure. The membrane is physically (manual flushing with distilled water) and chemically (submerging the membrane into a cleaning agent) cleaned. A cylinder vessel having constant volume is connected to the digester. This configuration allows the digester to maintain constant volume despite variation in membrane flux. The digester is kept at a moderate temperature by recirculating water. The headspace of the AnMBR is connected to an alkali hydroxide solution trap to absorb the CO<sub>2</sub> from biogas. A phenolphthalein indicator is added to ensure that the alkali hydroxide solution is not neutralized.

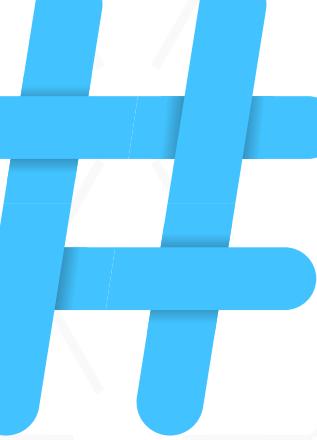
## ADVANTAGES OF MBR

The MBR technology provides High-quality clarified and largely disinfected product, higher volumetric loading rates, shorter hydraulic retention times (HRT), longer solid retention times (SRT), less sludge production, and potential for simultaneous nitrification / de-nitrification over the conventionally used CAS process. The MBR technology came into the picture due to the limitations of the previously used CAS process. CAS consists of screening, sedimentation followed by biological treatment with activated sludge, and followed by secondary sedimentation by gravity. The end products were treated-water and excessive sludge. The processing of sludge was a tedious job, it included operations like anaerobic stabilization, thermal reduction, chemical conditioning which increased the cost of treatment. This excess treatment was about 50-60% of the total cost of water treatment. However, in MBR the yields of sludge were comparatively a bare minimum which is shown in the studies mentioned below. A study on the production of sludge in an MBR was reported to be 0.12 gVSS gCODremoved<sup>-1</sup>, whereas in a study on conventional aerobic membrane separation process used for municipal wastewater treatment ( $488 \pm 143$  mg COD/L) was 0.23 kgSS kgCOD removed<sup>-1</sup>. SRT or Solid retention time is a key parameter in wastewater treatment. In CAS, the flocs are allowed to grow in size, this allows the secondary clarifiers to remove it by settling. Due to which the settling ability is related to HRT or Hydraulic retention time. This results in a coupled SRT. While in the case of MBR, the biological solids are retained this ensures that the SRT and HRT are not related and are uncoupled.

The pore size of the membrane used in MBR is  $<0.5\text{ }\mu\text{m}$ , the small pore size of the membrane allows highly clarified effluent and reduced pathogen concentration as compared to that of the CAS process. The effluents from MBR can be directly used for urban irrigation, or can directly be discharged into water bodies.

The increase in SRT results in a much better biotreatment. This condition allows the growth of the slower growing micro-organisms such as Nitrifiers which are highly effective in removing ammonia in a biological method.

**- Nethra and Hrishithashree,  
Department of Chemical Engineering,  
III Year**

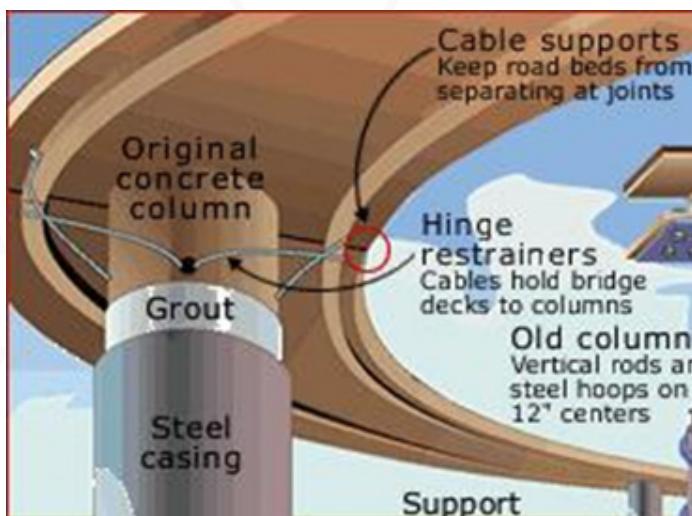


# DEPARTMENT OF CIVIL ENGINEERING

## SEISMIC RETROFITTING TECHNIQUES



Seismic retrofitting is the modification of existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes. With better understanding of seismic demand on structures. Retrofitting of existing structures with insufficient seismic resistance accounts for a major portion of the total cost of hazard mitigation.



Thus, it is of critical importance that the structures that need seismic retrofitting are identified correctly, and an optimal retrofitting is conducted in a cost-effective fashion. Once the decision is made, seismic retrofitting can be performed through several methods with various objectives such as increasing the load, deformation, and/or energy dissipation capacity of the structure. Conventional as well as emerging retrofit methods are briefly presented in the following subsections.



AFTER RETRO-FITTING ATTIC



BEFORE RETRO-FITTING ATTIC

## **Retrofit of Structures Using Modern Materials**

Current research on advanced materials in civil engineering is mainly concentrated on high performance concrete and steel, and fibre reinforced plastic (FRP) composites. FRP composite materials have experienced a continuous increase of use in structural strengthening and repair applications around the world in the last fifteen years. High specific stiffness and specific weight combined with superior environmental durability of these materials have made them a competing alternative to the conventional strengthening methods. It was shown through experimental and analytical studies that externally bonded FRP composites can be applied to various structural members including columns, beams, slabs, and walls to improve their structural performance such as stiffness, load carrying capacity, and ductility. FRP composites have enjoyed varying degrees of success in different types of applications.

In general, applications that allow complete wrapping of the member with FRP have proven to be effective. Wrapping of columns to increase their load and deformation capacity is the most effective and most commonly used method of retrofitting with composites. However, certain performance and failure mode issues regarding different wrapping configuration and fibre orientations, still need to be well understood. When wrapping is difficult or not allowed, such as when strengthening beams, slabs, or walls, success of the method is sometimes hindered by premature de-bonding failures.

Limited research and applications regarding seismic retrofitting of building systems with FRP composites have shown that composites retrofitting does not significantly alter the stiffness and dynamic properties of the building. The main benefit of retrofitting with composites is the increase in deformation capacity of the building, and in its load capacity to an extent. This may achieve the retrofit objectives for buildings with lightly insufficient seismic resistance. For buildings with large seismic deficiencies, a combination of conventional and FRP strengthening techniques may prove to be an effective retrofitting solution.

As a practical and economical solution, the retrofit design involved replacement of the existing window frames with structural steel frames constructed from steel C-sections. A verification analysis of the retrofitted building showed that installation of steel window frames largely decreased the stress concentrations, but did not suffice to reduce all stresses to acceptable levels. For this reason, additional retrofitting was designed using externally bonded FRP composites around the openings in the walls to prevent or delay concrete crack propagation by bridging the stresses at crack locations. Thus, by combining conventional and innovative materials, an effective and economical retrofit design was achieved that did not significantly interfere with the function or historical and architectural character of the building. FRP composites are widely recognized for their potential use in seismic retrofitting applications. To achieve wide-range use of these materials, however, there is need for further research into a number of issues related to mechanics, design, and durability of FRP retrofitted concrete and steel systems. Despite considerable progress in these areas since early last decade further improvements are necessary to meet the needs of the retrofit industry. Failure mechanisms, with emphasis on brittle shear and bonding failures, must be thoroughly understood and associated design procedures must be incorporated in design codes.

Influence of cyclic and fatigue loading on the FRP strengthened member performance must be characterized and accounted for in the design process. Although FRP composites are known for their favourable durability characteristics, only limited information is available on long-term durability and performance of FRP bonded concrete and steel systems. These issues need to be investigated through accelerated test studies and related design, application and protection requirements must be included in the design codes.

**- Bargavi A,  
Department of Civil Engineering,  
IV Year**

# OVERVIEW OF NET ZERO ENERGY BUILDING (NZEB)



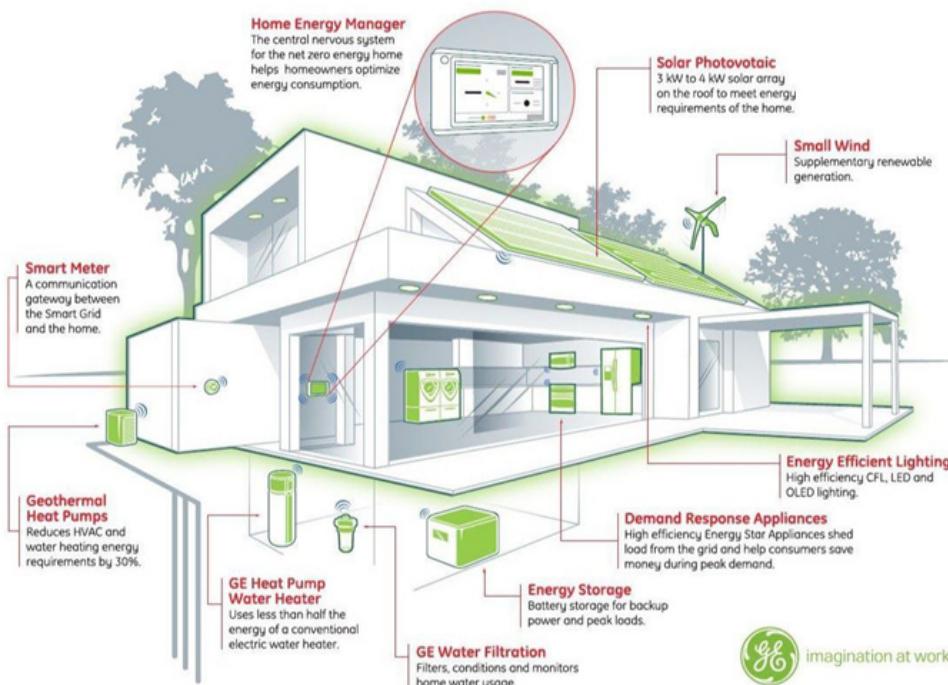
Buildings have a significant impact on energy and the environment. Commercial and residential buildings use almost 40% of the primary energy and approximately 70% of the electricity and it continues to increase. Toward this end, the U.S. Department of energy has established an aggressive goal to create the technology and knowledge base for cost effective **net zero energy buildings(NZEBs)** by 2025.

## NET ZERO ENERGY BUILDING

- In NZE buildings, the amount of energy used is equal to the amount of renewable energy created on the site.
- During the last 20 years more than 200 reputable projects claiming net zero energy balance have been realized all over the world.
- 40% of the world's energy is consumed by buildings and 21% of greenhouse gas emissions come from buildings. NZEB consequently contributes less overall greenhouse gas to the atmosphere.

## WHY NZEB ?

1. Reduces energy consumption.
2. Reduces greenhouse gases and global warming.
3. Reduces dependence on fossil fuels.
4. Reduces ozone depletion.
5. Reduces climate change.
6. Protects our environment for future generations.



## **STEPS TO ACHIEVE NET ZERO ENERGY BUILDING**



### **1. Sealing and Insulating**

Sealing and insulating the home's floors, walls and ceiling is absolutely essential. Once it is done, its level of airtightness must be verified with a 'blower door' test.

### **2. Continuous ventilation**

An NZE home needs a continuous source of clean air to keep it dry, healthy and comfortable. ERV(energy recovery ventilation) and HRV(heat recovery ventilation) systems are designed to meet this challenge by expelling old air while extracting heat from it, then recycling that heat energy back into the house.

### **3. Solar energy**

An NZE home's lot and window orientation should make full use of the sun, which will drastically lower the home's energy needs for indoor heat and lighting. Well placed solarPV(photovoltaic) panels are the most cost efficient collectors of alternative energy available today for net zero energy homes.

### **4. Efficient HVAC( Heating,Ventilation and Air conditioning)**

Installing a super efficient, money saving HVAC system is your next priority when building a net zero energy home. Ductless heat pump systems are extremely economical and much cheaper to operate. In addition, air and drain water heat recovery devices efficiently harvest and reuse energy.

### **5. Energy conservative water heater**

An NZE home's water heating setup typically requires a substantial portion of its energy budget. So it is important for builders to install an efficient system from the variety of currently available water heating technologies to make sure the home's energy needs stay within "net zero" range.

### **6. High efficiency appliances**

In the average NZE home, nearly half of its energy consumption goes to heating and cooling the air and water, and appliances ordinarily make up about 60% of that amount. As a result, installing ENERGY STAR appliances that are protected against 'phantom' energy loss is essential.

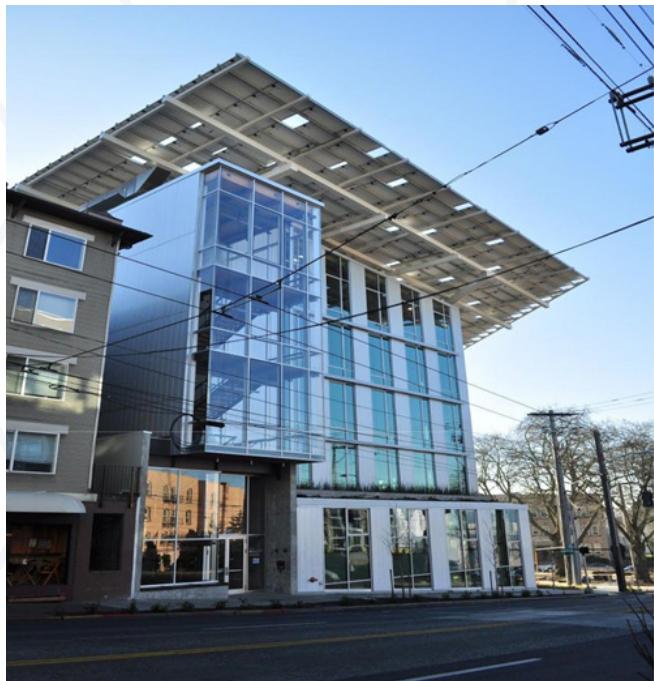
## 7. An Energy Dashboard

Many NZE homes include a special dashboard or control panel that allows owners to gauge their property's energy usage and generation . Using this handy tool, they can make any modifications they need to keep their home's energy input and output balanced.

*Following the above steps will ensure the building has all the crucial elements it needs to be certified as a genuine NZE property.*

### **APPLICATION:**

#### **THE BULLITT CENTER**



The bullitt center seattle was opened on Earth day on April 22,2013. It is rated as the greenest commercial building in the world.

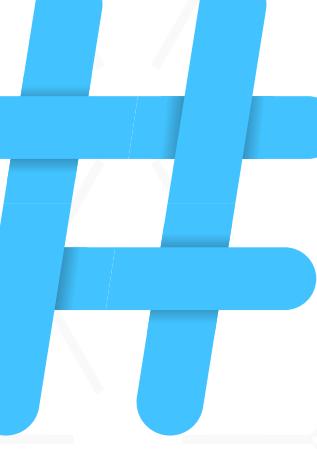
It is a six storey building and has a total area of 52,000ft<sup>2</sup>.

The building is energy and carbon neutral and the center's efficiency is 83% better than a typical office in Seattle with many efficient and sustainable energy sources including a 242 kW photovoltaic array, retractable external blinds that block heat from warming the building.

For the water usage aspect, the center is 80% more efficient than a typical office in Seattle with live rainwater to potable water systems that can collect up to 56,000 gallons of rainwater. The building also uses gray water reclamation using composting

foam flush toilets that save up to 96% of water as compared to traditional flush toilets.

**- Abithoo Dass.A.D,  
Department of Civil Engineering,  
IV Year**



# DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

## Neuromorphic Computing

*“The ultimate mystery is one’s own self” – Sammy Davis Jr.*

In 1965, Gordon Moore, one of the original fathers of the microprocessor industry, postulated that the transistor density per chip would double every two years. Even though it was just a simple prediction, Moore's law revolutionized the electronics industry, serving as the benchmark standard for several decades. As the transistor density increased, processor performance improved in leaps and bounds. However, the whole situation is all set to change as the transistor count has neared saturation. Yes, Moore's law will no longer be in effect in a few years' time. To solve the potential threat the industry faces, computer scientists were tasked with finding out an alternative solution to the computing crisis. The answer was, quite literally, beneath our noses!

One of the most profound marvels of nature is the human brain. Through billions of years of evolution, the human brain has perfected its own design. We may not realize it, but our brains process several things ridiculously fast. Composed of a labyrinth of 86 billion neurons and about 3 trillion synapses, it doesn't differentiate between memory and processing and it perceives and understands our surroundings and physically rewires itself to adapt to changes, a phenomenon known as neuroplasticity. Tasks such as facial/voice recognition, cognitive reasoning and abstract thinking are childishly simple for the human brain, yet most of these tasks are near to impossible for even the most powerful supercomputers in existence today. The brain does all this and more, just requiring about the average energy to power a dim light bulb and it occupies just about, well, the size of our heads.

Even though we haven't fully understood it yet, the human brain has inspired a radically new approach to computing architecture. Termed as neuromorphic computing, this new and exciting concept tries to model a computer based on the design of the human brain. All present-day conventional computers are designed with the von Neumann architecture stating that a system consists of an input/output unit, a processing unit and a separate memory, all connected to each other via buses. However, such systems' speed would directly depend on the information transferring capacity of the aforementioned buses, a phenomenon known as the von Neumann bottleneck. However, neuromorphic computers are designed as non-von Neumann machines in which there is no delineation between memory and processing units thereby completely eliminating the necessity of a bus. Such a computer would theoretically be able to achieve never-before-imagined speeds utilizing just a fraction of the power of conventional computers. However, designing neuromorphic computing systems isn't without its own set of challenges.

The very first roadblock was the unavailability of a reliable component to mimic a neuron. In 1971 a paper published by Leon Ong Chua proposed a theoretical electronic component called as the memristor (memory + resistor) whose resistance can be programmed and subsequently stored. Unlike RAM, a memristor does not lose data upon loss of power and unlike flash memory, the memory access time of a memristor is very small, thus offering the best of both worlds. However,

it wasn't until 2008 that an actual memristor was fabricated. This ushered in the dawn of a new era in the field of neuromcomputing. Current models of neuromorphic computing work by interconnecting several neurones (hardware equivalent of neurons) together. Information is stimulated by means of spiking potentials of the neurones and data transfer occurs either temporally (potentials stacked up over time until a threshold is reached) or spatially (several spiking potentials in the vicinity). Since the whole system is a deterministic network of neurones, there is no partition between the memory and the processing unit. This makes the whole system look chaotic on the outside but studies have shown that performance is greatly improved in this case. Another major impediment is the non-availability of softwares that can run on present neuromorphic models. All conventional software implementations are designed keeping the von Neumann architecture in mind. Exporting such a software directly to a neuromorphic system would be counter-productive. Until neuromorphic computing becomes a de-facto standard, this obstacle is less likely to be addressed.

Perhaps the single greatest use of neuromorphic computing is the championing case of running Artificial Intelligence models. In what takes traditional computers several gigabytes of storage and several hours or even days for training, a neuromorphic computer would be able to achieve the same task in a few hours with just a single chip of storage-cum-processor. Neuromorphic computing is no longer in its nascent stage. The European Union funded Human Brain Project (HBP) has led to two major initiatives, the SpiNNaker and the BrainScaleS projects dedicated to modelling the complete anatomical and morphological structure of the human brain. Intel has developed a neuromorphic system called Pohoiki Beach consisting of 8 million synapses and neurones. The core of Pohoiki Beach comprises of 64 of Intel's prototype Loihi chip with 128 cores fabricated on the 14nm process technology. IBM too isn't far behind with its TrueNorth system comprising of 64 million neurones and 16 billion synapses. However, the whole of TrueNorth is shrouded in secrecy, hence the exact specifications are not well known and merely speculative in nature.

As interesting as it is in the field of cognitive and perceptual reasoning, neuromorphic computing holds the greatest promise in finally understanding the inner workings of the brain. One day, humankind may even finally be able to answer the most fundamental question, the question of one's own consciousness.

**- Akash Murugan,  
Department of ECE,  
III Year**

# Quantum Computing - A modern treasure trove

Picture this: A spinning totem from the movie Inception. What if, you can determine the state of this universe or any 'parallel universe' depending on which point the totem drops. Since the totem is a top-like structure, a lot of possible points for it to fall on , so an infinite possibilities of states , meaning so many states of the universe are possible/'simulatable' ? Wow.

The principle of a quantum system is quite similar. Consider this analogy - Classical computing is like working with coins - one can obtain only 2 states - heads or tail. So, 1 or 0 for a classical computer. Now, a 'classical' computer refers to any of the computing systems that we have now - think of normal computers and processors that are built using logic gates. A quantum computer works in a dimension of a sphere or a top - there are no definite number of states. It exists in what is called a 'Superposition'.

## **What is Quantum Computation?**

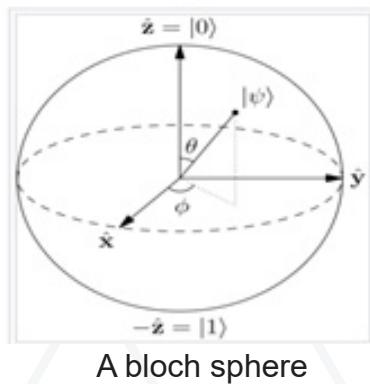
Few terms that would help in understanding the concept better are the following:

**Qubit:** Qubits posses a state - either a  $|0\rangle$  or a  $|1\rangle$ , called the computational basis state. The difference between classical bits and qubits is that qubits don't necessarily exist in discrete states. It's more often than not that they exist in the linear combination of these 2 states, something like:

$$|\psi\rangle = a|0\rangle + b|1\rangle$$

**Multiple qubits:** 2 classical bits yield 4 states - 00,01,10,11. Similarly, a pair of qubits will yield the linear combination of the 4 basis states,  $|00\rangle, |01\rangle, |10\rangle, |11\rangle$ , whereby the amplitude of each basis state determines the overall state. This linear combination is what is referred to as Superposition.

**Computation:** Changes that occur to a quantum state is described as quantum computation. Analogous to a classical computer built using wires and gates to manipulate bits , a quantum computer is built from quantum circuits containing elementary quantum gates. A general means of visualising a single qubit is a Bloch Sphere, a three dimensional unit sphere to locate the exact state of the qubit using the parameters  $\phi$  and  $\Theta$  .



## **What are the possible applications of Q.C and to what extent have they been implemented?**

Quantum cryptography, Superdense Coding and Quantum Teleportation are few of the coolest of it's many applications. To give an idea of Quantum cryptography - Quantum key distribution (QKD) is implemented whereby keys are distributed over a public channel and the security of these keys is

guaranteed by a fundamental property of quantum information - observation in general disturbs the system being observed. Thus, if there were an eavesdropper between the communicating parties, it would be a visible disturbance to the quantum system.

Though these quantum techniques are not widely in practice, they give an idea of what can be made possible.

### ***Latest Updates from around the world:***

Here are a few companies focused on Quantum technologies:

#### **Google :**

In 2019, the company claimed “quantum supremacy” over the most powerful supercomputers in the world by solving a problem considered virtually impossible for normal machines using its developed quantum computer, named Sycamore.

The company’s website has a repository of open-source frameworks that are designed for developing novel quantum algorithms.

#### **IBM:**

IBM is the first company to put a quantum computer on the cloud. Since 2017, the company has been offering universal quantum computing systems via the **IBM Q Network**.

The IBM Q Experience is an online platform that gives users in the general public access to a set of IBM’s prototype quantum processors via the Cloud, an online forum for discussing quantum computing relevant topics, a set of tutorials on how to program the IBM Q devices, and other educational material about quantum computing..

#### **The Quantum Scene In India:**

In 2020 during the Union Budget session, Rs 8,000 crore was allocated for quantum computing over a period of five years by the government, stating that it would be used for a National Mission on Quantum Technologies and applications.

Many research institutes have turned their focus on this domain. **Initiative on Quantum Technology (IQT)** is a research centre setup in IISc to deliver quantum enhanced technologies. Other institutes that are involved in this domain are:

- I. Quantum Information and Computing (QuIC) lab at the Raman Research Institute, Bangalore
- II. Quantum Measurement and Control Laboratory (QuMaC) at TIFR, Mumbai

**- Soundarya V,  
Department of ECE,  
IV Year**

# DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

## HYPEROLOOP

Developments in transport and communication systems have brought the world closer together in many ways. This is one such development. We have come across many modes of transportation—land, air, water. But imagine sitting in a capsule and traveling through a tube. Sounds farfetched? But in reality, it is a lot closer than you think.

Initially, the concept of hyperloop was proposed by Tesla and SpaceX founder, Elon Musk. The idea emerged as a conversation between Musk and Silicon Valley investor, Shervin Pishevar when they were flying together. On August 12, 2013, Musk released the Hyperloop Alpha white paper.

The Hyperloop is a high-speed commuter and freight transport system that could reach speeds of around 750 mph (1,210 kph). Musk's initial design was to take people from downtown Los Angeles to San Francisco in 30 minutes – a distance of around 380 miles (610 km). Two of the biggest problems with moving vehicles are friction and air resistance. Hyperloop works by propelling specially designed pressurized pods or capsules using electromagnetic force inside a near-vacuum tube, to reduce air friction and drag.

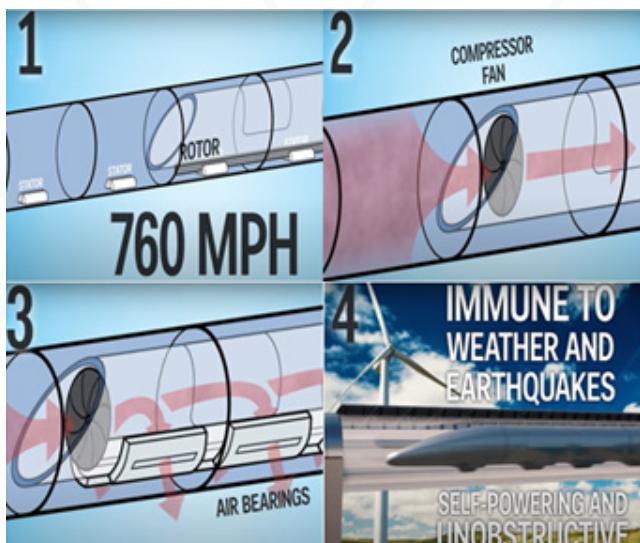


Fig 1: Musk's hyperloop model

Using the principles of fluid dynamics, thermodynamics, and electromagnetism Musk drafted an initial proposal that solved certain essential challenges theoretically. The passenger capsules are propelled by electromagnetic motors. The first challenge was getting around the Kantrowitz limit. It is a speed limit for objects moving in a tube. If we imagine a syringe moving in a tube and compress it, the air which is pushed outward forms an air cushion around the syringe, offering resistance and lowering the speed. Musk proposed that a compression fan must be kept in front of the capsule which will redirect the air to the back, which in turn furthers propulsion. The next challenge was to reduce friction. Musk's solution was to use air bearings. The air bearings were essentially a metre and a half paddles that use

the air around them to create pressurized cushions of air, on which the pod can ride. But according to his design, each passenger pod required 28 bearings. It's also not feasible to maintain a vacuum for such long distances. So, the hyperloop needs to be filled with low-pressure air. Now, all of this requires energy, especially for propulsion. Hyperloop will be propelled by a linear induction motor in which, a thin metal fin on the passenger pod will slide between the magnetic elements inside the tube. But magnetism requires electricity. Musk proposed that solar panels would be mounted across the whole length of the hyperloop tube. The panels would generate 120 W per sq.m. which would mean 57 MW of energy per year, which is more than what the hyperloop would use.

But Musk had stated that it was an open-source idea, thus allowing other start-ups and dedicated companies to work on it. Hyperloop Transportation Technologies (or HTT) were making aggressive advancements and constructed a full-scale test track in France, however, the clear leaders of the pack in the current standings, are Virgin Hyperloop One.



Fig 2: First hyperloop passenger test

Deviating slightly from Musk's original plan, Virgin Hyperloop One's technology combines two basic principles. The first is magnetic levitation (or "MagLev"), a technology already used in monorails to lift the passenger pods and move them along their rails. Magnetic levitation uses two sets of magnets; one to repel the train from the track and lift it upwards and the other to move the floating train along the track at considerable speed with reduced friction. The second principle is the use of low pressure, vacuum-sealed environment for the passenger pods to travel through.

Virgin Hyperloop made history in November 2020, when it completed the world's first Hyperloop passenger test. Company Co-Founder and CTO Josh Giegel and Director of Passenger Experience Sara Luchian were the first to ride Virgin's new form of transportation: Experimental Pod-2 (XP-2). Tied to the two-seater XP-2, the pair made their maiden voyage to Virgin's DevLoop test site in Las Vegas, where the company has previously conducted more than 400 unoccupied tests. The prototype vehicle was designed with many of the safety systems that passengers can expect in a future commercial hyperloop, which will feature larger cars that seat 28 people and travel at speeds of up to 670 mph.

Virgin Hyperloop came to India in 2017 and has been working with the Maharashtra state governments on the Mumbai-Pune project to build the world's first commercial Hyperloop corridor. Besides, India is in the race to be the first place where the actual commercialization of the project could take off. Virgin Hyperloop is looking beyond Maharashtra as well. They announced a partnership with Bangalore International Airports (BIAL) to conduct a feasibility study for a proposed Hyperloop corridor from Bangalore Airport. They also signed an MoU with Punjab's transport department.

- **Sowmya G,**  
**Department of EEE,**  
**IV Year**

# ION PROPULSION-FURTHER, FARTHER, AND CHEAPER!

Since the beginning of space exploration, people have always been fascinated by the powerful rockets and spaceships that have aided man to venture into the vast abyss. The earliest advent into space programs began with chemical rockets, like NASA's Saturn V that sent Apollo to the lunar surface. But, what if one of the most powerful propulsion systems produces less than one pound of thrust while reaching greater speeds, with lesser cost, and uses lesser fuel than the former?

Ion thrusters, which have always been the choice of propulsion for avid science fiction writers, have become the primary choice for engineers in various space organizations. The ion propulsion system's efficient use of fuel and electrical power enables modern spacecrafts to travel farther, faster, and cheaper than any other propulsion technology currently available. Ion thrusters are being designed for a wide variety of missions—from keeping communications satellites in the proper position (station-keeping), to interplanetary transportation. These thrusters have high specific impulse ratio of thrust to the rate of propellant consumption, so they require significantly less propellant for a given mission than would be needed with chemical propulsion.

An ion propulsion engine ionizes the propellant by adding or removing electrons to produce ions. Most thrusters ionize propellant by electron bombardment. The gas produced consists of positive ions and electrons in proportions that result in no over-all electric charge. This is called plasma. The most common propellant used is xenon, which is easily ionized and has a high atomic mass, thus generating a desirable level of thrust when ions are accelerated. It also is inert and has a high storage density which makes it convenient for storage on spacecraft. In most ion thrusters, electrons are generated by a process called thermionic emission. Electrons produced by the discharge cathode are attracted to the discharge chamber walls, which are charged to a high positive potential by the voltage applied by the thrusters' discharge power supply. The positively charged ions migrate toward grids and are accelerated out of the thrusters as an ion beam, which produces the thrust.

The implementation of ion propulsion in space vehicles commenced as early as the 1950s. From 1998 to 2001, the NASA Solar Technology Application Readiness (NSTAR) ion propulsion system enabled the Deep Space 1 mission, the first spacecraft propelled primarily by ion propulsion, to travel over 163 million miles and make flybys around the asteroid Braille and the comet Borelli.

However, with the advent of electric propulsion using ion thrusters, many space organisations aim to improvise on this technology to extend the operational life and minimize the operational cost. Currently, NASA aims to design two different ion thrusters: the NASA Evolutionary Xenon Thruster (NEXT) and the Annular Engine. NEXT is a high-power ion propulsion system that seeks to reduce the cost and duration of the mission. Annular Engine, with a novel design that yields an annular beam area twice as that of the former, promises to exceed the performance capabilities of the NEXT ion propulsion system and other electric propulsion engine designs.

Modern space exploration is reaching areas only once dreamed about. With our next pit stop being our neighbouring Red Giant-Mars, it is safe to say that the future of space travel and exploration looks promising, exciting, exhilarating, and electrifying!

- **Sreemugi R,**  
**Department of EEE,**  
**IV year**



# DEPARTMENT OF INFORMATION TECHNOLOGY

## Human Data

Mankind has seen a tremendous change in the way people interact with one another in the past decade or two. The advent of social media has played a crucial role in realizing the idea of a 'global village'. Platforms such as facebook started off as a forum to connect with friends, but later expanded into a marketing platform to advertise businesses, ideas and sell products. Highly trained algorithms are put in place by these companies, to literally 'sell' the audience's attention to the advertisers.

Each impression made on the audience rolls in revenue from the advertisers. But, how do these algorithms identify their audience? The answer is simple, User Data. The basic forms we fill up for signing up into these social media websites gives them objective data, like place of stay, place of work etc, but the subjective data such as behaviour is obtained as you start using these websites. The kind of friends you have, the posts you share, the people you message, the videos you stop and watch, all these activities give away a lot of personal information you never intended to give. This information is consolidated to create a list of your preferred topics, and ads targeting these topics are auctioned into your feed to maximise the chance of your interaction.

The growing popularity of sharing photos online has fueled the success of apps like snapchat, where a lot of information regarding your surroundings and lifestyle is posted. Also, synchronisation of your gadgets with google cloud gives an almost real time picture of your activities and preferences. Cloud synchronisation of health gadgets such as a fitbit, constantly keeps collecting all body parameter values and storing them to the cloud. This information needs to have high security so that it doesn't result in unforeseen consequences.

Home Automation Systems such as Google Home and Amazon Echo create an integrated ecosystem with all devices at the residence under their radar. They collect and store information on your living preferences, and pretty much have every detail about the residence.

The idea of a personalized experience comes at the cost of constant human data collection by various gadgets and applications. The quality and quantity of data collected puts the collecting companies at a position of power over the providers. If put into an appropriate model, this data can do wonders. Along with advertiser revenue for the companies, the user satisfaction rate also increases.

But, if taken over by unlawful entities, disaster could ensue from this data. From using your social media pages to promote unwanted content to committing white collar crime, anything is possible. Medical data, if stolen can lead to fraudulent insurance claims, resulting in huge losses.

Thus, it is of utmost importance for us to know where we are sending our data. Data security must never be compromised upon in the name of personalization. Part with your personal data online, only when absolutely needed, that too after reading the terms & conditions carefully. Immediately report any digital abnormalities, for it is better to be safe than end up sorry.

- **Sowmya K,**  
**Department of IT,**  
**IV Year**

# Robotic Process Automation

Robotic process automation (RPA) is a technology that enlists the help of bots, programs that can perform repetitive tasks directly from a user interface. Fast to deploy and easy to update, bots can be powerful catalyst for system integrations and process automation.

## ***The basics of robotic process automation (RPA):***

Today's organizations use a wide variety of business applications. When a legacy platform, web application, or in-house system lacks enterprise integration functionality, this can create a step in a business process where employees have to do manual work to keep information and content moving between systems. This is an "automation gap" that software bots are particularly suited to fill. RPA bots work directly from an application's user interface, mimicking the actions a person would perform, including logging in and out, copying and pasting data, opening emails and attachments and filling out forms. While this functionality may sound similar to screen-scraping or application macros, RPA has evolved beyond these solutions. For example, while macros follow a pre-determined script of fixed, linear commands, bots have the flexibility to learn over time and intuitively respond to changes in a business processes. Also, in cases where you need multiple tools to run scripts for each business application, RPA can simplify the way users automate tasks by interacting with multiple applications at once.

The dynamic nature of robotic process automation makes it ideal for organizations that want to deploy integrations and automation solutions quickly in response to need or a changing business climate.

### **Benefits of RPA:**

The business benefits of RPA include:

- Low technical barriers
- Increased accuracy
- Meet regulatory compliance standards
- No interruption of work
- Existing systems remain in place
- Improved employee morale and employee experience
- Increased productivity

## ***A virtual business assistant:***

We may think of RPA in the context of organization-wide processes, but it can be applied as a personal productivity tool as well. Employees will be able to identify many opportunities for robotic process automation in their daily work where bots can assist.

With RPA, employees are empowered to automate their more routine daily tasks, regardless of technical expertise. This low barrier to entry enables employees across the enterprise to benefit from RPA, even if there isn't a resource-intensive, organization-wide deployment.

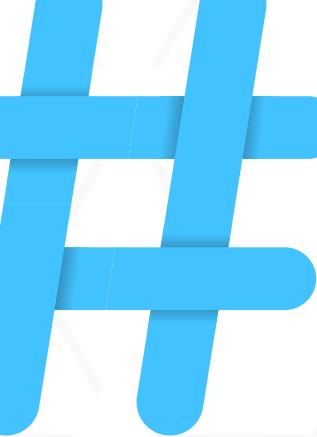
Furthermore, since all bots can be monitored and audited over a centralized server, IT would still be able to manage bots in use, while promoting flexibility in the organization for employees to deploy their own custom solutions.

Having a bot as a de-facto virtual business assistant can help employees offload time-consuming, routine tasks in favor of high-impact projects and elevating the customer experience.

### **RPA as part of the digital transformation journey:**

RPA can be an important tool in solving automation challenges and pushing organizations to grow into digital workplaces. However, it is just one part of an organization's digital transformation toolkit. Going beyond automating everyday repetitive tasks, RPA combined with traditional content services and business process management technologies can help organizations further maximize their potential as they make the most of their automation strategies. Robotic process automation is an ideal technology for reducing costs and increasing productivity. Whether optimizing end-to-end automation initiatives or enabling employees to be more efficient in handling projects, RPA is a powerful addition to any business process automation platform.

**- Rohini K,  
Department of IT,  
IV Year**



# DEPARTMENT OF MECHANICAL ENGINEERING

## Solar Window

What if every window in your house could generate electricity? Yes, it is possible by using the “transparent solar cell coating” technology.

Transparent solar cell coating on windows can be used to convert sunlight into electrical energy without needing conventional solar panels. These coatings can be applied to the tempered glass walls of skyscrapers; windshields in automobiles as well as the screen on mobile phones, thus transforming any glass surface into a solar cell.

The transparent solar cell coating on the windows selectively absorbs ultraviolet and near-infrared light while letting visible light through it. The electricity is then harvested using ultra-thin wires on the glass that are barely visible to the naked eye. The current is transported to an interconnection point and finally, into the building’s power system. Solar windows can be especially beneficial for large buildings that don’t have the roof capacity to hold conventional solar panels that would offset their energy usage. Since, the solar windows can capture sunlight throughout the day and convert it to energy; they can be the last missing piece that large buildings need to be totally independent of traditional energy.

The key factor that allows solar windows to surpass conventional solar panels is its ability to produce more electricity by utilizing less space. Moreover, the transparency of the solar windows adds two great benefits. The first one is that it preserves the aesthetics of the building. The second advantage is its ability to be integrated into existing window structures without destroying them. In addition to that, the solar windows can be manufactured at relatively low cost.

With the recent breakthroughs in solar window technology we can be sure that future homes, cars, and even phones, will be using glass to generate part of their energy demand. Scientists estimate that solar windows can meet 80% of the electricity demand in the US. Utilizing vertical space and existing structures could potentially provide us with clean renewable energy with the lowest carbon emissions and land footprint.

- **Gautam R,**  
**Department of Mechanical Engineering,**  
**III Year**

# UNLOCKING INDIA'S POTENTIAL IN THE SPACE SECTOR

Space is terrifyingly vast and immense. It contains remnants of our past, might hold the key to understanding our current existence and the possibilities of our future. All this quite literally, comes at a cost. In fact, the numbers associated with space exploration is so mind boggling that it might leave many wondering, 'Is spending that much cash really worth it?'

Some of the premier government agencies such as NASA (National Aeronautics and Space Administration) and ESA(European Space Agency) have opened their doors to facilitate collaboration with private companies. This dynamic relationship between both fosters growth and innovation through the exchange of data and information. Such steps can advance the scale, volume and precision of missions, and more importantly cut costs borne by the government.

Towards the end of 2020, India took its first big step in that direction with the central government setting up New Space India Limited (NSIL) and IN-SPACe (Indian National Space Promotion and Authorization Centre).

NSIL (a PSU under the Department of Space) has come up as an assisting body for ISRO to engage with startups and private companies for new applications and use their space infrastructure to build them. IN-SPACe will provide a level playing field for private companies by hand-holding industries in space activities through encouraging policies and a friendly regulatory environment.

The private industry is already involved in 80% of the production of satellites and rockets in India, largely as suppliers of systems. ISRO has already been actively engaging the industry to manufacture its small satellite launch vehicle and polar satellite launch vehicle. By bringing reforms to open up our space sector to private players it will allow ISRO to be able to better utilize its resources in taking up developmental activities of the government such as building next gen rockets, satellites and deep space missions, as well as to meet the increasing demand of space based services and applications.

India already has over 50 space technology startups that not only compete for local market share, but also eye the country as a hub to design and manufacture satellites and launch them at competitive rates using indigenous rockets. Here are a few of the most exciting ones to come up in recent times:

**Skyroot Aerospace**, a Hyderabad-based startup launched in 2018, became the first private company to test upper-stage rocket engines. The 3-D printed rocket engine named after Nobel laureate CV Raman weighs less than half of conventional rocket engines with a similar capacity. Founded by Pawan Kumar Chandana and Naga Bharath Daka, who worked at ISRO earlier, Skyroot plans to make a 'family of rockets' and launch them in space. Skyroot is also developing a futuristic, highly efficient LNG/LOX Cryogenic liquid engine that uses greener, more sustainable rocket fuel. Their first rocket, which can hurl satellites of 250-700 kgs into a lower Earth orbit, is expected to be launched by the end of 2021.

**AgniKul Cosmos**, is a company that is based out of the National Center for Combustion R&D at IIT-Madras. Started by Srinath Ravichandran and Moin SPM in 2017, the start-up provides a dedicated launch vehicle for smaller satellites at a lower cost. AgniKul is also using 3D printing to build most of its launch vehicles thereby cutting costs.

The Department of Space (DoS) has signed an agreement with them under IN-SPACe, enabling AgniKul to work closely with the Indian Space Research Organization to help develop a launch vehicle. They are currently building India's first private small satellite launch vehicle called 'Agnibaan',

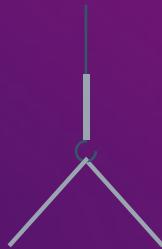
which will be capable of carrying up to 100 kg of payload to low Earth orbits up to 700 km with a plug-and-play engine configuration.

**Bellatrix Aerospace** is a private Indian aerospace manufacturer and small satellite launcher headquartered in Bangalore, India. The company was established in 2015. It is the first startup in India that has begun working on technology development with the Indian Space Research Organization. Founded by Rohan Ganapathy and Yashas Karanam, Bellatrix Aerospace is also the only domestic enterprise working on electric propulsion, key to replacing conventional engines on satellites. Conventional satellites use chemical propulsion systems which result in the fuel required taking up most of the possible payload. The company's innovation - Microwave Plasma Thrusters (MPT) - which is in the process of being installed in Indian satellite systems, makes them lighter and cheaper. These MPTs will use water as a propellant as opposed to any chemicals. This also results in making the process eco-friendly.

They also have plans to launch their own rocket in the near future.

*- Akshaya R,  
Department of Mechanical Engineering,  
III Year*

# Projects & Internships



# Team MedTex from SSN win IEEE COVIDMOVE Hackathon 2.0

By

M.C.SAI KAVYA NEHARIKA S. SHWETHA

M LOKESH KUMAR

SAKTHIVEL SUKEERTHI

Biomedical Department- III Year

IEEE India Council organized a 3-day national online IEEE COVID-19 hackathon, from 17th April to 19th April 2020 to develop innovative solutions for the problems caused due to the outbreak of the COVID19 virus. This pan India event saw more than 500 registrations with 61 teams participating across industries and academia. Among them, 10 were selected as finalists and 4 winners were declared.

Team “MedTex” comprising of M.C. Sai Kavya Neharika - 2nd year BME - IEEE member, S. Shwetha - 2nd year ECE, M. Lokesh Kumar - 2nd year BME, Sakthivel Sukeerthi - 2nd year

M.E Medical Electronics, bagged the coveted first prize for their project titled “Corover 2020”, under the mentorship of Dr B Geethanjali, Associate Professor, SSN College of Engg. The IEEE authorities are in discussion with concerned authorities to push the idea presented for use by government/public authority.

The esteemed jury members were Mr. Puneet Mishra (Head, Satellite Antenna Characterization, Test & Design Section at U R Rao Satellite Centre/ IEEE Bengaluru), Mr. Bala Peddigari (Principal consultant & Technology Head-TCS / IEEE Hyderabad), Dr. Vaibhav Srivastava (Professor-IIT

Kanpur/IEEE UP) and Mr. Girish Khilari (CTO & Director at Elliot Systems/IEEE Pune).

Many studies show that mass sanitization can be done effectively by means of UV-C lamps and disinfectant sprays during this pandemic. The far-UV-C rays alter the RNA of the pathogen and prevent its further multiplication, while aerosol sprays disintegrate the protective lipid coating. The proposed device is a simple robot having four wheels and two motors which can either use far-UV-C-rays to disinfect distances up to 180 cm, or, can spray disinfectant through an ultrasonic nozzle towards specific areas. Since this can be used in the disinfection of large areas, it meets the need for mass sterilization effectively, with minimal cost. An important feature of this product is that, it can be used even after the pandemic abates. UV sterilization is very effective and reduces the transmission of four major superbugs by a cumulative 30 percent. The cost for prototype development would be of Two types: Manually controlled (roughly 20,000 - 25000) and Fully Automatic(Approx. 40,000 - 45,000). As more features are added, the cost will increase accordingly. It is important to mention

that there are existing products in the market offered by companies such as UVD robotics. These pre-existing devices cost around 90,000 to 1,00,000 USD. In comparison, this indigenous product is designed to be manufactured within a short time, without compromising on the efficiency, at a fraction of the cost. An option to sterilize isolation wards and waiting rooms using disinfectants, in case of failure of the UVC lamp, is also provided. As of now we have designed a bot for the purpose of disinfection of hospitals and isolation wards. This can further be implemented for sanitisation of Public spaces such as airports, Malls, Schools.etc. Further of Applications of this Idea could be in Hand held Far UVC devices that can disinfect Groceries and other home utilities. Sanitisation of



N-95 masks with use of Far UVC can help in the reuse of the mask, thereby reducing Biomedical waste.

In the hackathon, there was another team that came up with a similar idea, which focused on only sterilizing the floor. It is neither considered if the surrounding equipment and furniture might be contaminated, nor allowed for sterilization using disinfectant.

Shwetha S, the second year ECE student remarked, "It was an exciting experience and it was enlightening to see how different teams devised solutions for the problems caused by the pandemic.

## **INTERNSHIP AT NCCR**

**S. HARISH**  
**Chemical Department**  
**IV Year**

Catalysts have always intrigued me, the ability of these simple chemical compounds to enhance the rate of a chemical reaction by 3000 to 4000 times the original rate is analogous to Rajinikanth in cinemas who single-handedly lifts the mood of the whole audience irrespective of the quality of the movie. Catalysts can be perceived as the marquee player or the hero of the whole chemical industry. These compounds provide an alternate path requiring low energy of activation which enhances the reaction rate and subsequently reduces the overall cost of the process. Catalysis is a domain where the principles of both chemical engineering and chemistry coalesce and produce a synergistic effect to improve the reaction process.

Fortunately, I had the chance to learn and synthesize these special compounds at the National Catalysis Centre for Research (NCCR) which is a part of the chemistry department at IIT Madras. This research center heads the research in catalysis in India. Myself And four of my friends were given individual catalysts to prepare and were assigned to separate Ph.D. scholars who guided us throughout the interning period. The main aim of our internship was to synthesize catalysts and apply them to industrially important reactions such as photocatalysis, liquefaction, and hydrogenation reactions.

Before making catalysts, literature knowledge of various preparation techniques and a thorough understanding of all the characterization techniques like

XRD, SEM, TEM, and BET adsorption studies were primal. Studies from various previously published research papers helped us to understand the exact mechanism of the reaction and the crucial role played by various chemicals that were added to prepare catalysts. I focused on preparing mesoporous, ordered titanium oxide catalysts with silica as the support material. Though the compound titanium oxide can easily be obtained by a simple reaction between two chemicals, the preparation of highly ordered and mesoporous structured TiO<sub>2</sub> was a herculean task. The mesoporosity and orderness imparted high performance and efficacy to the catalyst and the more porous the catalyst is, the more is the surface area available for substrate conversion.

Working on this intern helped me realize the importance of catalyst and how it is a crucial ingredient in the various chemical process. Results weren't obtained in a single take, I prepared various batches of catalysts until I finally got the required three peaks in low angle XRD analysis which indicates the formation of an ordered structure. I learned that doing proper research in any field requires a lot of patience and a phlegmatic approach. Among all the researchers only 1-2% of people succeed whereas others learn from their previous mistakes and keep on trying. I found a different approach to research which focused more upon improving the quality of research rather than increasing the number of publications for their

research group. I also had a chance to attend a Ph.D. review of a scholar in the chemistry department. The level of scrutiny and perfection required by the professors was intimidating at first but later I realized it was for the good of the scientific society. Hearing the stories of research scholars who were there for more than 5 years and we're still aiming for perfection in their studies shows the passion these people had for research.

Through this internship I got the chance

to work at IIT Madras and I cherished every moment of it. Interning at this premium institute helped me to realize my dream of doing research and produce some significant results to change the way we live. Though our internship period was unfortunately stemmed due to the COVID-19 pandemic, I enjoyed the moment while I was there and had the first-hand experience of working in one of the most intriguing concepts of Catalysis.

# Research Internship at Adobe Systems

**NETHRAA SIVAKUMAR**  
**ECE Department- III Year**

My selection for the much sought-after summer internship at Adobe Systems was something which I could have never imagined! Having taken Biology as a subject instead of computer science for my 12th standard board exams, catching up and improving my coding skills was a major challenge for me and thinking about interning at a dream product company like Adobe was beyond bounds. But after my selection for the internship, I can proudly say that one will always reap the rewards of hard work and the most important part of the whole placement process is to have a positive and open mind.

### **Before the Internship Drive:**

Mathematics, logical reasoning and analytics have always been my strength and my interest in these has been unshaken for years. When I entered college, there was one main goal which I wanted to achieve within the end of my 4-year degree. I wanted to hone my skills in Statistics and Mathematics and make them my forte. This journey began with me attending many workshops and seminars that SSN organized throughout my first year. I paid heed to the Tech Club heads who suggested that I try out as many domains as possible before I settle for one. By the end of my first year, I had attended all kinds of workshops ranging from Internet of Things to Image Processing to Big Data. While I wasn't sure about what I really enjoyed doing, I was sure that it had to be related to Mathematics.

My second year began with full swing and we got introduced to the concept of "Internally Funded Student Project" (IFP). I decided to take the unconventional path by approaching a senior professor (Dr. B Praba) of the Mathematics Department. It was not because I wasn't interested in ECE related fields but simply because I wanted to pursue my passion. General perception was that it may not be ideal to pursue a project outside my department. However, I decided to tread a different path which I believe was a game changing decision for myself!

The IFP that I did in my second year was based on Fuzzy logic. I hadn't dealt with this subject before but my mentor, Dr. B. Praba patiently guided me on every concept during our weekly meetings. We went on to implement a model for Facial Expression Detection with a novel approach. Over the months that I spent on this project, I learnt so much, not just in terms of the subject, but also how to approach real world problems and working towards finding feasible solutions. The IFP gave me a well-



rounded understanding on all aspects involved in a project.

## **Adobe Internship Selection Process:**

This will be a 3-month Research Internship at Adobe Systems, Bangalore in summer 2021. The internship placement was conducted virtually for female students of the college. Over 400 applicants from the college took part in two rounds of tests. After clearing the first test, my confidence got a boost and I decided to put in extra effort for the second one.

While the first round involved aptitude and coding questions, the second one also included essay and gamified assessments which made the test interesting and challenging.

Along with coding,

Adobe also gave emphasis on the other 3 sections and this helped me to crack the test successfully. 3 students were finally selected for a live interview. The interview was rigorous and lasted 35 minutes. It involved questions about

the projects mentioned in the resume, Machine Learning and Artificial Intelligence concepts and finally, a few tricky puzzles. Finally, after facing two days of anxiety and nervousness, I was informed about my selection to the prestigious internship program!

SSN has provided so many opportunities and avenues to thrive on. I took advantage and participated in everything that the college provided. I did not hesitate to do what I love and am passionate about just because it's different from what others around me did. An honest and undying effort is all it took to achieve this dream.

I would like to thank the management and the Principal, SSN CE for arranging such great internship opportunities. I would also like to thank the Head of the Department

(ECE) and all my professors for helping and continuously motivating me. Lastly, all of what I have managed to do so far wouldn't have been possible without the support and encouragement that my parents gave me throughout my journey!



# TOWARD IRON SKIES

SATHYAJITH S S

Mechanical Department- IV Year

L&T Defence is one of the few privately owned companies granted defence contracts and is responsible for the manufacture of a wide variety of military grade equipment, ranging from missile components to avionics and armoured vehicle upgrades. Their main customers are DRDO, ISRO, and HAL with a couple of international customers, mostly based in Israel, UK and France, like the IAI-Israel, MBDA-France and MBDA-UK.

The facility I interned was located in Coimbatore, which could most aptly be described as a gigantic multiplex with state-of-the-art manufacturing equipment. Working at the Precision Manufacturing Complex or PMSC for

short, was a great learning experience, primarily because of my own interest in aerospace sector. I was able to get an up close and personal view of the of all of the five machine shops located within the forty-four acre premises and given a broad overview of the purpose of each one, including the various stages each component passed through before finally being approved.

Much of the composite structures at the facility is manufactured in the Composite and Aero-structure Assembly Shop and involves building airframes, heat shields for missile and space launch vehicles and wing structures for fighter aircrafts. Other jobs include heat treatment and

testing of Motor Casings for Space Launch Vehicles as well as performing validation tests for the electro-mechanical items.

What grabbed my attention was the meticulous approach each employee had toward their tasks, especially the structured and efficient way they performed their roles and managed safety precautions. This was possible because the facility operated on a unique model called, “THE PMSC PRODUCTION SYSTEM” which combines philosophies from Theory Of Constraints, LEAN Manufacturing, and 6-Sigma, all of which enabled a very fast conversion of “Projects to Product.”

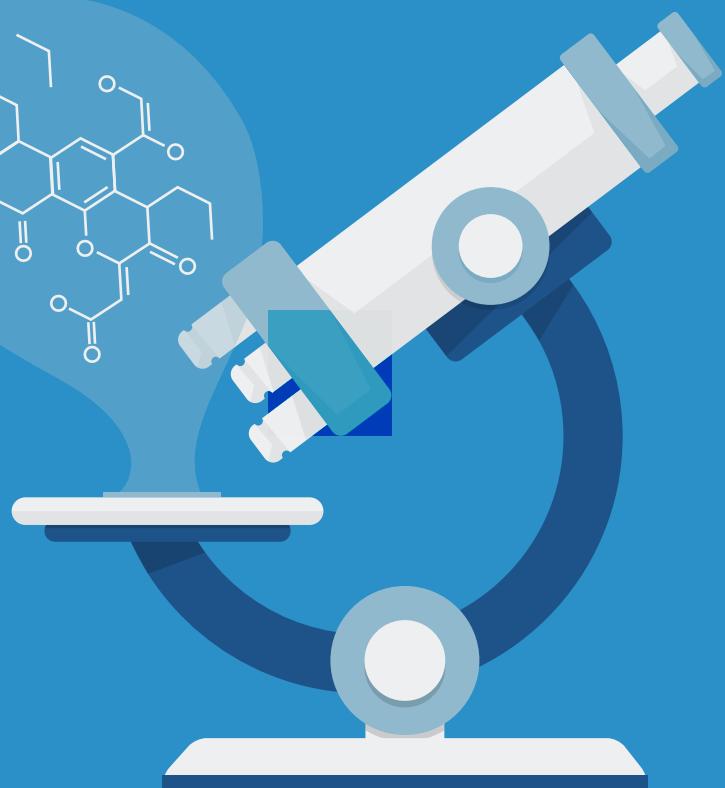
Work at the facility begins early in the morning and typically continues through the night, and is separated by shifts for the entirety of the week. My own work at

the facility involved assisting the PMSC engineers for the assembly of the SSLV shroud and the PSLV 2/3 U connector. I also tested the ENCM which would be incorporated into the missile systems while also providing assistance for the PSLV’s rolling operation. Additionally, I was given the responsibility of compiling the improvisation process, titled “DEEPAM”, for each of the manufacturing processes.

I am deeply thankful for the opportunity, the wonderful guidance and kindness shown to me by my guide and the PMSC engineers. It was a great learning experience and I would highly recommend all those interested in a career in the aerospace sector to consider an internship at L&T Defence.



# EXCELLENT RESEARCH



2021

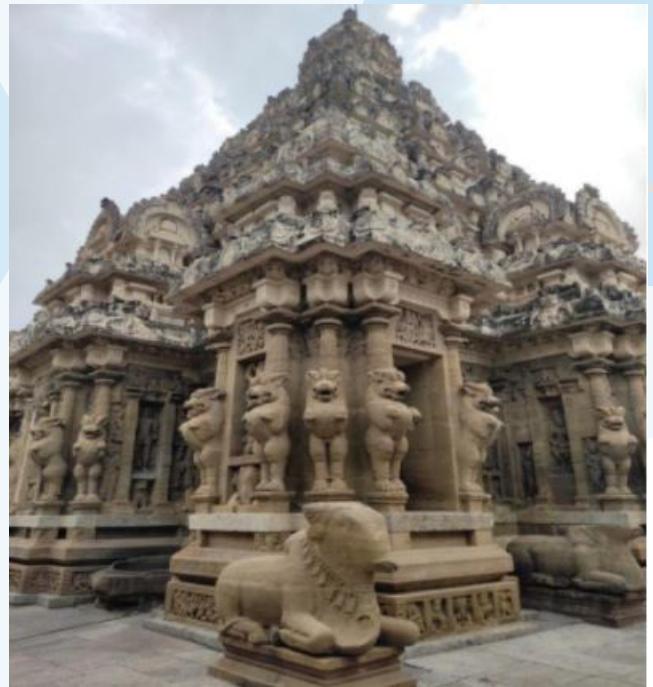
## Civil Engineering

Herbert Hoover, the 31st President of the United States of America said about engineering, “It is a great profession. There is the fascination of watching a figment of the imagination emerge through the aid of science to a plan on paper. Then it moves to realization in stone or metal or energy. Then it brings jobs and homes to men. Then it elevates the standards of living and adds to the comforts of life. That is the engineer’s high privilege.”

Engineers are the most influential people in the community and Civil engineering is a profession that has grown manifold along with human beings adapting to our world. It is the oldest profession which is ever perpetual. Undoubtedly our ancestors were virtuoso in Civil engineering and architecture. The architectural marvels of India and especially Tamil Nadu are living examples of it. One of the two major marvels are the Kailasanathar Temple, Kanchipuram and the Brihadeeswarar Temple, Thanjavur.”

## The Kailasanathar Temple, Kanchipuram

Kailasanathar Temple is believed to be one of the oldest Hindu temples to have been built and is dedicated to Lord Shiva. It was built between 685 to 705 AD. The main shrine and the majority of the temple construction was done by Rajasimha Pallava. His son, Mahendravarman III completed rest of the construction later. It is one of the architectural icons of the Pallava dynasty.



Granite is used as the foundation stone to provide a strong and stable base. The entire structure is made out of sandstone. At the entrance, devotees are greeted with a huge Nandi statue, luscious green garden and the temple pond providing a connect with the nature. Across them there are 8 cave shrines with a Shivalinga in each of them acting like a curtain wall to the main temple. The Gopuram asymmetrically stands in between them. The pillars are carved with lions which are symbolic of Pallava architecture. Shrines or Meditation Caves

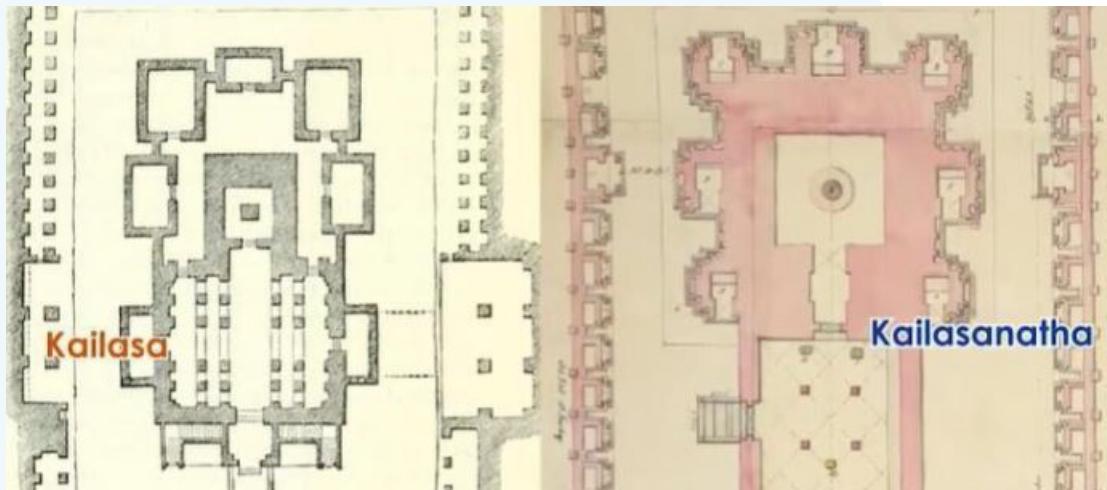


All around the temple Prakaram there are meditation caves which are big enough for people to sit and it is believed that Sadhus used to meditate in these. The outer facing walls of the meditation caves are intricately carved with sculptures of Shiva-Parvati or Ganesha. There is a pillared Mandapam in front of the main shrine which is believed to be joined with it by building an Ardha Mandapam.



Pillared Mandapa of the temple

The main shrine chambers a Shivalingam made from black granite. It is 16 sided and is 6 feet high and 3 feet in diameter. It has a circumambulatory passage surrounding the inner sanctum, which is the place of the Lingam. One must climb a flight of stairs and crawl out of a narrow hole, pass through a narrow passage and repeat the same on the other side which has a similar hole. It is believed that this temple is the inspiration for the Brihadeeswarar temple in Thanjavur and the Kailasa temple at Ellora. It is also a proven fact that the architecture of both Kailasanathar temple at Kanchipuram and Kailasa temple at Ellora is strikingly similar.



*Plans of Kailasanathar temple, Kanchipuram & Kailasa temple, Ellora showing similarity of stepped pyramid in the center*

### The Brihadeeswarar Temple, Thanjavur

**The Brihadeeswarar temple is one of the architectural marvels of the Chola empire who were known for being great temple-builders. During the reign of Rajaraja Cholan temple building was at its peak and they were not just places of worship but also centres of cultural exchange and learning.**





**Inscriptions on the temple walls**

The temple was built in the early 11th century CE. The temple has beautiful sculptures and paintings and is considered valuable because of the Tamil inscriptions all around the temple which serve as records of various events that had taken place at the temple. It is believed that approximately 130,000 tons of granite was used in the construction of the temple. The Kumbam is carved out of a single granite rock and weighs around 80 tons. The Vimanam (temple tower) is 216 feet high and it is still a mystery as to how workers were able to carry a 80 ton carved stone atop without any cranes or lifting machines. The temple consists of the Srivimanam, Ardhamandapam (front pavilion), Mahamandapam (assembly hall), Mukhamandapam (community hall) and a Nandimandapam in the front. The Nandimandapam has a beautiful carved monolith of Nandi, the vehicle of Lord Shiva, which weighs around 25 tons.



**Nandi statue**

*The defensive structure of the temple consisting of a moat and fortification walls makes this temple unique. On the outside there are two other enclosure walls and the outer wall, which was later added in 1777 CE, had gun holes which served as a defence purpose. The fortified walls have two Gopurams. A Mandapam in the north-eastern side and two Gopurams on the eastern side walls complete the temple complex.*

*The temple is a feast for the eyes with its intricately carved sculptures and beautiful paintings depicting stories from the lives of Lord Shiva. There are 108 dance postures carved all around the first storey of the temple proving the fineness of Chola art.*

*The Brihadeeswarar Temple of Thanjavur, the Gangaikondacholapuram Temple and the Airavateshwara Temple at Darasuram constitute the list of UNESCO World Heritage Site designated as the ‘Great Living Chola Temples’.*

*These temples are hardly a percentage of the construction and architectural marvels of the state of Tamil Nadu yet are outstanding examples of how skilled our ancestors were and the pride that each Tamizhan should have.*

**Janani J**

**Final Year BE Civil Engineering  
SSN College of Engineering, Kalavakkam**

## Chemical Engineering

Recent availability and easy access to nanometric scale characterization have paved the way for a detailed analysis of novel materials. Over the past few decades, a lot of shaped carbon materials have been synthesized and characterized.

One such particle is the spherical carbon material synthesized by the hydrothermal method that has drawn great attention due to their peculiar physical, chemical, and mechanical properties, they have a long history of the study. Carbon Spheres (CS) are said to be made of carbon layers emanating from the core, held by van der Waals force of attraction. Good adsorption capacity, size and shape control, minimal surface energy are few such properties. As the reaction time increases uniform-sized carbon spheres are obtained. It is because of the economic benefit, higher efficiency, and green properties that Hydrothermal Method is used CS synthesis. CSs can be solid, core-shell, or hollow and for nanometric texture, CSs can be concentric radial or random layers.

Based on the reaction time and peculiar morphologies of carbon spheres, its formation is considered as four stages: nucleation, carbonization, isokinetic growth, and corruption. Nucleation theory, Gibbs free energy of CS help in a better understanding of the growth procedure of carbon spheres in a solution. The diameter of CS is a wide range from a few nanometers as in onion to microns as obtained from polymerization. The spheres can be doped or functionalized. Doped spheres can be obtained by generating carbon spheres by the use of a carbon source containing the doping element or by doping the pre-synthesized carbon spheres. Nitrogen is the frequently used doping element. The physical properties, structure, or morphology are characterized by SEM, TEM, X-ray diffraction, and spectroscopy. The applications of carbon spheres in chemical engineering is a wide range.

### Synthesis:

The synthesis of CSs can be broadly classified into two, firstly, based on reaction temperature used for the sphere synthesis. In the presence of Concentrated HCl, polyvinyl pyrrolidone was allowed to react with 99% ethylene glycol under constant stirring. The solution is then autoclaved in a drying tunnel at 160°C for five to twenty-two hours, then was allowed to cool down at room temperature and a black precipitate was collected, washed, and dried for six hours at 80°C producing brown solid samples of CSs. The morphologies and size distribution of the sample were characterized using Scanning Electron Microscope (SEM). Reaction time is a key factor in the synthesis of CS. With a reaction time of 5 hours particles with a diameter of nearly 100nm agglomerated, with 6 hours reaction, regular spherical shaped smooth surfaced with diameter 150nm to 1.4 μm were observed.

At 9 hours reaction time, spheres with a diameter of 2.7  $\mu\text{m}$ , alike morphology and size were seen and at 13 hours ultra-similar structures were obtained. At the complete completion time i.e. 22 hours, spheres with a uniform average diameter of 3.4 $\mu\text{m}$  and surface corruption are observed. Secondly, arc discharge techniques, chemical vapor deposition, and many more. Autoclave methodologies are also used for sphere synthesis. The reaction of carbon-containing reagents can occur either in the presence or in the absence of a catalyst. The five crucial factors considered in the growth mechanism include the formation of carbon black precursors, the inception of carbon black particles, agglomeration of nuclei into the particle, surface growth, and post oxidation.

### **Applications of Carbon Spheres:**

In general, carbon spheres are used as catalyst support, injectable scaffolds for tissue regeneration, drug delivery, lithium batteries, dye encapsulation, and magnetic data storage. Such a wide range of applications is mainly due to thermal stability, large surface area, range of structures, and good electronic properties.

### **Carbon Sphere as CO<sub>2</sub> sorbent:**

The major source of energy even today are fossil fuels, emitting large amounts of carbon dioxide which in turn is polluting the environment. Out of several other options considered for the adsorption of CO<sub>2</sub>, the carbon sphere turns out to be the most efficient due to its large porous volume, chemical stability, an affinity for CO<sub>2</sub>, cost efficiency, and the possibility for modification with heteroatoms. Adsorption increases with increasing surface area and porosity of the carbon spheres.

## Fuel cells and batteries:

**Mesocarbon microbeads (MCMB) obtained from petroleum residue by heat-treatment have a good scope in electrochemical cells and batteries. CSs, largely used in electrocatalysis. Platinum and ruthenium with CSs have promising results in the direct methanol fuel cell.**

## Extraction of nano pollutants:

**The recent increase in the use of nanomaterial for the commercial production of products will lead to the contamination of pollutants in the near future. The number of adsorbents as of now for the removal of such emerging pollutants is less. One such adsorbent is the carbon sphere. These are used for the extraction of citrate-crapped gold and silver nanoparticles from water.**

Pooja S

**Third Year, Chemical Engineering  
SSN College of Engineering, Kalavakkam**

## BUILDING BLOCKS

One of the more recent innovations in material sciences, nanocomposites are already poised to become an important component of many applications. The basic concept behind these materials is the inclusion of nano-sized particles in the matrix of the composite giving a high surface to volume ratio and high aspect ratio. This results in various advantages like greatly improved mechanical strength, toughness, electrical and thermal conductivity.

## Mechanical Engineering

Nanocomposites can be of ceramic-matrix, metal-matrix, polymer-matrix, magnetic or heat resistant types. Materials like ceramic-metal composite of TiO<sub>2</sub> and Cu, tungsten disulfide nanotubes reinforced PPF nanocomposites, CNT reinforced nanocomposites and many more like these from an ever-expanding list of examples have started to play a crucial role in a wide range of areas from the automotive sector to aerospace to biomedical.

**Super-hard nanocomposites are being used for cutting operations like drilling, turning and milling. From an automotive standpoint, these materials are being used to improve fuel cell technology, porous exhaust filters and coating systems. They have directly or indirectly led to improved functionalities with respect to safety, comfort and ecological imprint of the vehicles.**

**Nanocomposites are used as strengthening elements in aircraft construction for elements like the frames, stringers or the outer layer of the honeycomb structures in the fuselage and wings. These materials are especially of great use to the aerospace industry due to the ultimate need of weight reduction and high strength to weight ratio. Nano carbon-carbon composites act as base materials for missiles, space shuttles and re-entry vehicles. It is also used as a brake disk material and brake lining for military and civil aircrafts.**

**In the biomedical arena, research has led to important developments and has helped in making strenuous medical procedures easier to handle in many cases. Applications have been found in tissue engineering where restoration, maintenance or improvement of damaged tissues or organs are done. Recent findings have shown use of some nanocomposites in the healing of broken bones. Cellular therapies involving the injection of viable cells for treatment have benefited from the use of nanocomposites. Composite nanoparticles have also facilitated more efficient drug delivery systems.**

**Other uses can be found in improved efficiencies of catalysts, more accurate sensors, lithium ion batteries, gas storage devices and many more. General uses include sports goods (sturdier bicycle frames, tennis racquets, etc.), conducting paints, etc.**

*Despite these possibilities, there are only limited examples of industrial use of nanocomposites, mainly due to the challenges in processing and the cost involved. However, intense research in both metal and ceramic-based nanocomposites suggests that the days are not far off when they will be actually in use. The cost factor may be a particularly serious problem for general engineering applications, while this may not be the case for specialized applications in electronics, aerospace, biomedical and other sectors, since the advantages might far outweigh costs and concerns in these sectors.*

*With rapid research taking place, new applications across various fields being unfolded and steadily increasing monetary support from government and private scientific institutions alike, the impact of nanocomposites will become much more widespread very soon.*

**R Swamenathan**

**Final Year, Mechanical Engineering  
SSN College of Engineering, Kalavakkam**

## **Electrical And Electronics Engineering**

### **The leading candidate for taking electronic performance to the next level - GaN**

Wide-bandgap semiconductors ( Eg: Gallium Nitride - GaN) are materials with bandgaps in the range of 2 - 4 eV. These semiconductors permit devices to operate at much higher voltages, frequencies and temperatures than conventional semiconductors.

The high-temperature tolerance also means that these devices can be operated at much higher power levels under normal conditions, which makes them highly valuable in military, radio and energy conversion settings. The US Department of Energy believes they will be a foundational technology in the new electrical grid and alternative energy devices, as well as robust and efficient power components used in high energy vehicles from electric trains to plug-in electric vehicles.

The high breakdown voltage of wide bandgap semiconductors is a useful property in high-power applications that require large electric fields. Both gallium nitride and silicon carbide are materials well suited for such applications.

*Due to its robustness and ease of manufacture, semiconductors using silicon carbide are expected to be used widely in creating simpler and higher efficiency charging for hybrid and all-electric vehicles, reduced energy loss and longer life solar and wind energy power converters, and eliminate bulky grid substation transformers.*

*The automotive industry is undergoing a change from the internal combustion engine (ICE) to an all-electric future. The key elements of electric vehicles are the electric motors, battery, and all powertrain systems that control the transmission of current. The efficiency of the inverter affects the longevity of the battery charge as it drives the motor. Within an electric drivetrain, the traction inverter converts DC current from the electric vehicle's battery to AC current to be used by the motor to drive the vehicle's propulsion system. Improving the traction inverter's efficiency will enable:*

- 1). Longer range, fewer charging cycles, and extended battery life with the same battery cost.*
- 2). The use of smaller, lower-cost batteries to achieve the same range, both of which will help improve the viability of alternative vehicle technologies*

*GaN has an advantage in that it can run at very high frequencies at low losses. The need for Onboard Chargers in cars is important nowadays, in anticipation of better-charging infrastructure. The aim is to minimize the cost, size, and weight of the OBC and the required cooling system. This trend fits well with the advantages of GaN technology as it can switch quickly with low losses and therefore reduce costs for cooling solutions.*

**Moreover, gallium nitride costs less to produce than silicon carbide, thus benefiting inverter applications where a lot of semiconductors are needed. Both GaN and silicon carbide provide an advantage over existing IGBT technologies for the inverter.**

**Among its other advantages, GaN has a lower gate and output charge than an equivalent Si device. This enables GaN-based designs to achieve much faster turn-on times and slew rates while reducing losses. As a result, a GaN-based inverter reduces both conduction loss and switching losses in high-power applications. In EVs, these added efficiencies translate directly into longer range or equivalent range with a smaller battery.**

**The leading candidate for taking electronic performance to the next level is gallium nitride. The use of gallium nitride in applications such as power converters enable significant improvements compared to traditional solutions based on silicon: greater power efficiency, smaller size, lighter weight and lower overall cost.**

**GaN's ability to conduct electrons 1000 times more efficiently than silicon, while being able manufactured at a lower cost has now been well established. Silicon is out of gas, and hence, the new, higher-performing semiconductor material is emerging – GaN is on the rise.**

**Deekshitha S**

**Third Year, EEE**

**SSN College of Engineering, Kalavakkam**

# **Electronics And Communication Engineering**

## **Textronics**

The Textronics Design and Development Lab of the ECE Department is an exclusive lab for research on the production of electronic textiles. Textronics is the abbreviation for textile electronics and refers to a textile substrate that integrates capabilities for biological or external sensing, associated communication that is mainly wireless, power conduction, and interconnections that will allow sensors or actuators such as information processing devices to be networked together within a fabric.

**Electronic textiles** allow small bits of computation to occur on the body of an individual itself. They usually contain conductive yarns that are either spun or twisted and incorporate some amount of conductive material (like strands of copper or silver coated threads) to enable electrical conductivity.

The lab boasts of a novel computer controlled system, for fabrication of 4 layered e-textiles, which was designed and developed in-house. Solidworks professional was used for designing the control system framework. Aluminium sheets and blocks were used to develop the frame and control was achieved by combining electronic components and automating the motions for fabrication. The main controller used was Arduino MEGA with 86 servo motors, 2 stepper motors and 16 dc motors for performing the shedding, picking, beating and roll-up operations. The developed machine is as depicted in Fig.1. Inset is the control box with the controller, power supply and necessary drivers for the motors used.



**Fig 1. Complete machine picture.(inset) customised control box.**

The machine was designed to weave out a four-layered e-textile by binding them at the ends and the layers were separate in the areas other than the ends. For the fabrication of a fabric RF transceiver, conventional multilayer weaving won't work, owing to the fact that binding the patch, substrate and ground plane would introduce a short circuit in between the ground and patch, making the transceiver useless. Hence, to avoid the shorting of the conductive parts, binding was done only at the ends and the layers were woven out normally in the other areas.

The testing of the computer controlled machine was done by fabricating a 2.4 GHz antenna. The antenna was designed using CST Microwave studio and was fabricated as a four layered all textile antenna with the patch and ground planes done using zari threads and the two substrate layers made using cotton threads. The fabrication setup and output are as shown in Fig. 2.



**Fig.2. Machine with warped threads. Inset is the side view of the threads**

A state of the art, piezoresistive sensor for the detection of Kyphosis has also been designed and developed using the computer controlled machine. The sensor used fibrous cotton structures coated with a solution consisting of piezoresistive material. The prototype was fabricated using three layered weaving in the developed computer controlled machine. Fig 3 (a), (b), (c) and (d) show the warped threads and the fabricated prototype. To make the sensor a complete wearable, the fabricated prototype was interfaced with Arduino UNO to form a system for kyphosis detection.



**Fig. 3. (a) Warped threads in machine (b) Side view of the warped threads (c) Fabricated piezoresistive sensor (d) Felt outer covering.**

**Research has also been focussed on the use of microwaves that can be effectively used for developing low cost testing (sensing) devices for various applications including healthcare. The lab has developed a cost effective wearable alternative to polysomnography for the diagnosis of obstructive sleep apnea, along with Kaveri Hospitals. The developed product was successfully tested at Kaveri Hospitals, Chennai. The lab has also developed end products for socio-friendly applications such as location tracking for fishermen at sea.**

**The automated loom in itself is a product that can help alleviate the occupational health hazard of weavers that includes musculo skeletal problems, tendonitis, and carpal tunnel syndrome. The presence of infirmities like eyesight weakness, joint pain, allergy to dust and back aches cause a reduction in productivity of these weavers. Hence this automated loom would help in the overall upliftment of weavers and work toward reducing the reduction in our native weaver population.**

**Since the lab is involved in the production of wearables, we are acutely conscious of the fact that the work we do can have adverse effects on the human body. The lab is driven with the strong belief that research for research's sake cannot be encouraged in this scenario. Hence, most of our research is oriented toward applications where the pros outweigh the cons and where the requirement for technology is deemed to be completely necessary. We have worked exclusively on problems that have a direct positive impact on society. The use of research for betterment of society is the sole aim for the establishment of the lab!**

**Dr. Esther Florence S  
Associate Professor  
Department of ECE**

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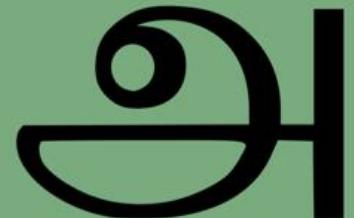
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